CONNECTICUT RIVER FLOOD CONTROL PROJECT

BIRCH HILL DAM

MILLERS RIVER, MASSACHUSETTS

SPECIFICATIONS

FOR

CONSTRUCTION OF DAM

AND

APPURTENANT STRUCTURES

WAR DEPARTMENT, CORPS OF ENGINEERS, U.S. ARMY

U.S ENGINEER OFFICE, PROVIDENCE, R.I.

Invitation No. 699-40-271

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND

March 23, 1940

ADDENDUM NO. 2 to Invitation No. 699-40-271, dated March 4, 1940, for the construction of Birch Hill Dam at South Royalston, Massachusetts, bids to be opened April 3, 1940.

1. The following changes are made in the drawings:

a. Sheet No. 9, File No. CT-1-1344 - Modify Line denoting "Limit of Contractor's Work Area" by omitting triangular parcel of land northwest of abandoned railroad's right-of-way (stone fence northwest of railroad).

b. Sheet No. 11, File No. CT-1-1346, change Elevation 860.0 to Elevation 861 on view "Profile on center line Dam (looking upstream)," denoting first season construction limit.

c. Sheet No. 12, File No. CT-1-1347 - dimensions and notes on Highway Guard fencing to be modified as follows:

1. Change dimension of width of chain link 2-inch diamond mesh wire fencing from 2'0" to 3'0".

2. Change dimension from bottom of 3/8"x2"x3'-0" wrought iron plate to top of riprap from 10" to 6".

3. Change dimension from top of riprap to top of post from 3'0" to 3'8".

4. Add 7'0" dimension from top of post to bottom of post.

5. Change note reading "3/8"x2"x2'0" wrought iron plate" to "3/8"x2"x3'0" wrought iron plate."

6. Change note "Standard concrete highway post for details. See Sheet No. 40" to read "For shape and reinforcement details of post, see Post Detail on Sheet No. 40."

J. S. Bragdon,
Lieut. Col., Corps of Engineers,
District Engineer.

Invitation No. 699-40-271

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
PROVIDENCE, R. I.

March 14, 1940

ADDENDUM NO. 1 to Invitation No. 699-40-271, dated March 4, 1940, for the construction of Birch Hill Dam at South Royalston, Massachusetts, bids to be opened April 3, 1940.

1. The following changes are made in the specifications:

a. Page 10, Paragraph 1-07 b, line 3. - Change 860 to 861; line 12, delete "not caused by overtopping".

b. Page 15, Paragraph 1-19 c. - Change first sentence to read:

"The Boston & Maine Railroad along the left bank of the river will be relocated by other agencies by June 1, 1941."

c. Page 26, Paragraph 2-02, line 3. - Change 832 to 861.

d. Page 27, Paragraph 2-03 d, line 2. - Delete the following:

". . . and completion of the downstream cofferdam."

e. Page 97, line 2. - Change the period to comma, and add the following:

"except that the conduit for the basement lights shall be located in the floor slab instead of being installed as shown in Section B/48 on Sheet No. 49, Drawing CT-1-1384."

2. This addendum shall be attached to and made a part of your proposal.

J. S. BRAGDON
Lieut. Col., Corps of Engineers
District Engineer

CONNECTICUT RIVER FLOOD CONTROL PROJECT

SPECIFICATIONS

FOR CONSTRUCTION OF

BIRCH HILL DAM

MILLERS RIVER, MASSACHUSETTS

JANUARY 8, 1940

(ISSUED MARCH 4, 1940)

CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE PROVIDENCE, R. I.

No. _____ Bidder _____ Invitation No. 699-40-271
(Do not write above this line)

STANDARD GOVERNMENT FORM OF INVITATION FOR BIDS
(Construction Contract)

War Department,
United States Engineer Office,
Providence, R. I.
March 4, 1940.

SEALED BIDS, in duplicate, subject to the conditions contained herein, will be received until 2:00 P.M., Eastern Standard Time, April 3, 1940, and then publicly opened, for furnishing all plant, labor and materials and performing all work for the construction of Birch Hill Dam, located on the Millers River near South Royalston, Massachusetts.

I. THE WORK shall be in strict accordance with the specifications, bidding schedule, and drawings, designated as follows:

Specifications for constructing Birch Hill Dam on the Millers River, Massachusetts.

The drawings which will become a part of this contract are designated in Paragraph 1-04 of the specifications. Where copies of drawings are requested a deposit of 10.00 will be required to insure their return. This deposit should be in the form of a United States money order or a certified check, made payable to "The Disbursing Officer, U. S. Engineer Office, Providence, Rhode Island." The $10.00 deposit for each complete set of drawings will be refunded upon return of said drawings in good condition within 60 days after date of opening bids.

II. GUARANTEE will be required with each bid as follows: Bid Bond, Standard Form No. 24, will be executed in a penal sum approximately equal to and not less than ten (10) percent of the total amount of the bid. Individual sureties will justify in sums aggregating not less than double the penalty of the bid bond. (See Paragraphs 8 to 11, inclusive, of Instructions to Bidders.) Certified check may be furnished in lieu of bid bond.

III. PERFORMANCE AND PAYMENT BONDS will be required from the successful bidder as follows:

a. A performance bond with good and sufficient surety or sureties, for the protection of the United States, Standard Form No. 25, will be executed in a penal sum approximately equal to and not less than fifty (50) percent of the full amount of the consideration of the contract.

b. If the consideration of the contract will exceed $2,000.00 in amount, a payment bond with good and sufficient surety or sureties,

for the protection of persons furnishing material and labor for the work, Standard Form No. 25-A, will be executed in a penal sum equal to fifty (50) percent of the full amount of the consideration of the contract when the latter is not more than one million dollars ($1,000,000.00); forty (40) percent where the contract exceeds one million dollars ($1,000,000.00) but is not more than five million dollars ($5,000,000.00); and two million five hundred thousand dollars ($2,500,000.00) for all contracts above five million dollars ($5,000,000.00).

IV. LIQUIDATED DAMAGES for delay will be prescribed. (See Paragraph 1-07 of the specifications.)

V. TAX ADJUSTMENTS. - Provisions for tax adjustments will be made a part of the contract. (See Paragraph 1-12 of the specifications.)

VI. PARTIAL PAYMENTS will be made. (See Article 16 of the contract and Paragraph 1-10 of the specifications.)

VII. ARTICLES ON PATENTS will be made a part of the contract. (See Paragraph 1-18 of the specifications.)

VIII. BID AND CONTRACT. - a. Bids must be submitted upon the Standard Government Form of Bid and the successful bidder will be required to execute the Standard Government Form of Contract for construction. The bid form has an entry for each item on which estimates will be given or payment made, and no other allowances of any kind will be made unless specifically provided for in the specifications or the contract. Bids shall be for the entire work and have each blank filled.

b. The quantities of each item of the bid, as finally ascertained at the close of the contract, in the units given and the unit prices of the several items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

c. The successful bidder will be required to return the contract duly executed and to furnish the performance and payment bonds hereinbefore described, within ten (10) days after the papers are presented to him.

IX. EXPERIENCE. - a. Each bidder shall state in his bid whether he is now or ever has been engaged on any contract or other work similar to that proposed, giving the year in which it was done and the manner of its execution, and shall submit such other information as will tend to show his ability to prosecute vigorously the work required by these specifications.

b. The successful bidder will be required to employ an organization thoroughly experienced and skilled in the manufacture, fabrication and installation of the gates, gate hoists, gasoline-electric standby unit, power and lighting system, traveling crane and other equipment

of like nature. After the opening of bids, any bidder may be required by the contracting officer to submit satisfactory evidence that the specific organizations which he proposes to employ on those portions of the contract have successfully executed work of the nature and quality indicated above.

X. COMMENCEMENT AND COMPLETION. - Work shall be commenced within ten (10) calender days after receipt of notice to proceed and shall be completed within 550 calendar days, in accordance with the provisions of Paragraph 1-07 of the specifications.

XI. MINIMUM WAGE RATES for the locality of the work have been determined by the U. S. Department of Labor, and proof of payment of such wages will be required. (See Articles 17 and 19 of the contract and Paragraph 1-38 of the specifications.)

XII. EIGHT-HOUR LAW. - The requirements of the Eight-Hour Law, Article 11, of the contract, will be applicable to the work under the contract.

XIII. ARTICLES ON PREFERENCE for domestic materials will be made a part of the contract. (See Article 18 of the contract and Paragraph 1-34 of the specifications.)

XIV. REPORTS TO THE DEPARTMENT OF LABOR. - In order to assist the Department of Labor in obtaining employment statistics, bidders, unless otherwise indicated in their bids, will be considered as having voluntarily consented, without cost to the Government, to the inclusion of Paragraph 1-39 of the specifications as a part of the contract.

XV. INVESTIGATION OF CONDITIONS. - Samples of borings and from test pits taken at the site of the work can be seen at the U. S. Engineer Laboratory at Providence, R. I., where they should be inspected by prospective bidders. Bidders are expected to visit the locality of the work and acquaint themsselves with all available information concerning the nature of the materials to be excavated from the dam or structure excavations, the nature of the materials to be transported and placed in the embankment and the local conditions bearing on transportation, handling and storage of materials. They are also expected to make their own estimates of the facilities needed, the difficulties attending the execution of the proposed contract, including local conditions, availability of labor, uncertainties of weather, and other contingencies. In no case will the Government assume any responsibility whatever for any interpretation, deduction, or conclusion drawn from the examination of the site. At the bidder's request a representative of the Government will point out the site of the proposed operations. Failure to acquaint himself with all available information concerning these conditions will not relieve the successful bidder of assuming all responsibility for estimating the difficulties and costs of successfully performing the complete work.

XVI. FACILITIES AVAILABLE FOR CONSTRUCTION are described in Paragraph 1-06 of the specifications.

XVII. DATA TO BE SUBMITTED WITH BIDS. - a. Each bidder will be required to furnish with his bid a description of all the equipment, machinery, and apparatus that he proposes to furnish and install under the contract. Such description shall include the names of manufacturers, fabricators, and erectors of the equipment, together with such drawings, bulletins, catalog references, and other pertinent data in sufficient detail to completely illustrate and describe the equipment proposed.

b. Each bidder shall submit with his bid, drawings showing proposed plant layout and charts showing the rate of progress the bidder will maintain on the work, carefully prepared and presented in neat and legible form. These data are considered essential in assisting the contracting officer to determine whether or not the bidder is responsible, experienced in similar types of construction, and that his bid is based on a careful study of construction methods applicable to the work, and with a full realization of the various factors which may affect its progress.

c. The drawings indicating the plant layout shall clearly show the location and manner of employment of the various major items of plant, the method of excavation and disposal of materials, and the manner in which structural features will be erected.

d. The progress charts shall indicate the volume of work to be done and the rate of progress which the bidder agrees to maintain for each of the following major operations required in the performance of the work under these specifications: Cofferdams, Excavations, Concreting, Earth Embankment and Rock Fill. These charts may be in any convenient form in which the time element shall be plotted to represent definite intervals of time measured from date of notice to proceed with the work, and the volume of work shall be represented by a suitable scale of percentage of completion based on the estimated contract quantities. Careful consideration shall be given to the preparation of the charts as the contractor will be required to maintain the rate of progress indicated thereon.

XVIII. PLANT. - Each bidder shall state in his bid the character and amount of plant that he proposes to employ on the work. After bids are opened any bidder may be required to show that he owns, controls or can procure the plant necessary for commencing, prosecuting, and completing the work as required by the specifications.

XIX. AWARD OF CONTRACT. - a. Subject to the rights hereinafter reserved, the work will be awarded as a whole to one bidder. The right is reserved as the interest of the Government may require, to reject any and all bids, and to waive any informality in bids received.

b. A bid may be rejected if the bidder cannot show that he has the necessary capital and experience, and owns, controls or can

of like nature. After the opening of bids, any bidder may be required by the contracting officer to submit satisfactory evidence that the specific organizations which he proposes to employ on those portions of the contract have successfully executed work of the nature and quality indicated above.

X. COMMENCEMENT AND COMPLETION. - Work shall be commenced within ten (10) calendar days after receipt of notice to proceed and shall be completed within 550 calendar days, in accordance with the provisions of Paragraph 1-07 of the specifications.

XI. MINIMUM WAGE RATES for the locality of the work have been determined by the U. S. Department of Labor, and proof of payment of such wages will be required. (See Articles 17 and 19 of the contract and Paragraph 1-38 of the specifications.)

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XIV. REPORTS TO THE DEPARTMENT OF LABOR. - In order to assist the Department of Labor in obtaining employment statistics, bidders, unless otherwise indicated in their bids, will be considered as having voluntarily consented, without cost to the Government, to the inclusion of Paragraph 1-39 of the specifications as a part of the contract.

XV. INVESTIGATION OF CONDITIONS. - Samples of borings and from test pits taken at the site of the work can be seen at the U. S. Engineer Laboratory at Providence, R. I., where they should be inspected by prospective bidders. Bidders are expected to visit the locality of the work and acquaint themsselves with all available information concerning the nature of the materials to be excavated from the dam or structure excavations, the nature of the materials to be transported and placed in the embankment and the local conditions bearing on transportation, handling and storage of materials. They are also expected to make their own estimates of the facilities needed, the difficulties attending the execution of the proposed contract, including local conditions, availability of labor, uncertainties of weather, and other contingencies. In no case will the Government assume any responsibility whatever for any interpretation, deduction, or conclusion drawn from the examination of the site. At the bidder's request a representative of the Government will point out the site of the proposed operations. Failure to acquaint himself with all available information concerning these conditions will not relieve the successful bidder of assuming all responsibility for estimating the difficulties and costs of successfully performing the complete work.

procure the necessary plant to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work at the rate or time specified; and that he is not already obligated for the performance of other work which would delay the commencement, prosecution or completion of the work contemplated in this advertisement.

c. Any unbalanced bid which, in the opinion of the contracting officer, jeopardizes the interest of the Government, will be subject to rejection for that reason.

XX. ADDRESS FOR BIDS. - Bids submitted must be in envelopes with sufficient postage, sealed, marked and addressed as follows:

(Marked in upper left-hand corner)

Bid for construction of Birch Hill Dam, on the Millers River, Massachusetts.

To be Opened April 3, 1940.

(Addressed to)

District Engineer,
United States Engineer Office,
819 Industrial Trust Bldg.,
Providence, R. I.

Note:- See Standard Government Instructions to bidders and copy of the Standard Government Forms of contract, bid bond, payment bond, and performance bond, which may be obtained upon application.

TABLE OF CONTENTS

SPECIFICATIONS

SECTION I. GENERAL PROVISIONS.

DETAILED SPECIFICATIONS

Invitation No. 699-40-271
UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND

WAR DEPARTMENT

CONNECTICUT RIVER VALLEY FLOOD CONTROL RESERVOIRS, PROJECT NO. 65

APPROPRIATION: 21X3113 FLOOD CONTROL, GENERAL

SPECIFICATIONS FOR CONSTRUCTING BIRCH HILL DAM

SECTION I. GENERAL PROVISIONS

1-01. Location. - The site of the work contemplated by these specifications is on the Millers River about 27.3 miles above its confluence with the Connecticut River and about 1.3 miles northeast of South Royalston, in the Town of Royalston in Worcester County, Massachusetts. South Royalston is located on the Fitchburg Branch of the Boston and Maine Railroad and is about 10 miles from Gardner, 10 miles from Athol, 19 miles from Worcester, and 45 miles from Springfield, Massachusetts.

1-02. Work to be done. - a. The work provided for herein is authorized by the Flood Control Act approved June 28, 1938, (Public No. 761, 75th Congress).

b. The work to be done consists of furnishing all plant, labor and materials, except as furnished by the Government (see Paragraph 1-14 and Section XIV), and performing all work required for constructing a rolled earth fill dam, outlet structure, spillway, and all appurtenant works, complete in accordance with these specifications, and the maps and drawings forming a part hereof, together with such other incidental work at the site as may be required for the completion of the work within the intent and scope of these specifications or as may be ordered in writing by the contracting officer. It will consist of the following major items:

(1) Construction of outlet works consisting of an approach channel, a gate structure in concrete lined rock cut, an operating house, an outlet channel, and installing all gates and equipment.

(2) Diversion and care of river during construction.

(3) Construction of an earth dam by the rolled fill method with an impervious core, random and pervious outer shells, dumped rock fill slopes and an upstream impervious blanket.

(4) Construction of three ogee section concrete spillway weirs.

(5) Construction of access road and bridge, and road across dam.

1-03. Description of project. - a. The dam will be of the rolled earth fill type about 1,305 feet long at the top elevation of 864 feet m.s.l. with a maximum height above stream bed of about 58 feet. The central portion of the embankment will be of selected impervious material enclosed within random and pervious material, grading from finer sizes near the impervious section to coarser sizes near the outside slopes. The upstream and downstream slopes will be protected with dumped rock and each slope will be provided with a dumped rock toe. A blanket of impervious material will be provided upstream from the impervious core material.

b. The outlet works will be constructed in the right abutment and will consist of an approach channel, a gate structure in a concrete lined rock cut, and an outlet channel discharging into the original river bed below the dam. Four service gates and one emergency gate with operating machinery will be installed in the gate structure. Portions of the slopes and bottom of the approach channel and outlet channel will be lined with riprap and concrete paving for protection from scouring.

c. The spillway weirs will be constructed in a valley downstream from the dam and on the right (north)bank of the river.

1-04. Drawings. - a. The work shall conform to drawings marked "Connecticut River Flood Control, Birch Hill Dam," as listed below, which drawings form a part of these specifications and are filed in the United States Engineer Office, Providence, Rhode Island.

LIST OF DRAWINGS

Sheet No.	Title	File No.
1	Project Location and Index	CT-1-1343
2	Hydrographs	CT-3-1097
3	Plan of Subsurface Exploration	CT-2-1208
4	Record of Subsurface Exploration Logs No. 1	CT-2-1209
5	Record of Subsurface Exploration Logs No. 2	CT-2-1210
6	Record of Subsurface Exploration - Profile and Sections No. 1	CT-2-1211
7	Record of Subsurface Exploration - Profile and Sections No. 2	CT-2-1212
8	Borrow Areas and Record of Borrow Explorations	CT-2-1213
9	Work Area	CT-1-1344
10	General Plan	CT-1-1345
11	Embankment Details No. 1	CT-1-1346

OF THE RESERVOIR. ALSO, INTENSE STUDIES WILL BE MADE TO DETERMINE THE

Sheet No.	Title	File No.
12	Embankment Details No. 2	CT-1-1347
13	Spillway - Plan and Profile	CT-1-1348
14	Spillway - Sections	CT-1-1349
15	Outlet Works - Plan	CT-1-1350
16	Gate Structure - Plan and Elevations	CT-1-1351
17	Gate Structure - Details No. 1	CT-1-1352
18	Gate Structure - Details No. 2	CT-1-1353
19	Gate Structure - Details No. 3	CT-1-1354
20	Gate Structure - Steel Reinforcement No. 1	CT-1-1355
21	Gate Structure - Steel Reinforcement No. 2	CT-1-1356
22	Gate Structure - Steel Reinforcement No. 3	CT-1-1357
23	Gate Structure - Steel Reinforcement No. 4	CT-1-1358
24	Gate Structure - Steel Reinforcement No. 5	CT-1-1359
25	Outlet Works - Wall Details No. 1	CT-1-1360
26	Outlet Works - Wall Details No. 2	CT-1-1361
27	Walls - Steel Reinforcement No. 1	CT-1-1362
28	Walls - Steel Reinforcement No. 2	CT-1-1363
29	Miscellaneous Metal Details No. 1	CT-1-1364
30	Miscellaneous Metal Details No. 2	CT-1-1365
31	Gates and Accessories - General Arrangement	CT-1-1366
32	Gates and Accessories - Clearance for 15-ton crane	CT-1-1367
33	Operating House - Details No. 1	CT-1-1368
34	Operating House - Details No. 2	CT-1-1369
35	Operating House - Details No. 3	CT-1-1370
36	Operating House - Details No. 4	CT-1-1371

Sheet No.	Title	File No.
37	Operating House - Structural Steel No. 1	CT-1-1372
38	Operating House - Structural Steel No. 2	CT-1-1373
39	Access Road - Plan	CT-1-1374
40	Access Road - Sections	CT-1-1375
41	Access Road - Bridge	CT-1-1376
42	Access Road Bridge Steel Reinforcement No. 1	CT-1-1377
43	Access Road Bridge Steel Reinforcement No. 2	CT-1-1378
44	Reinforcement Schedule No. 1	CT-1-1379
45	Reinforcement Schedule No. 2	CT-1-1380
46	Reinforcement Schedule No. 3	CT-1-1381
47	Reinforcement Schedule No. 4	CT-1-1382
48	Electric Light and Power No. 1	CT-1-1383
49	Electric Light and Power No. 2	CT-1-1384

b. The work shall also conform to such other drawings relating thereto as may be exhibited in the office of the contracting officer prior to the opening of proposals and to such drawings used in explanation of details as may be required from time to time during construction, including such minor modifications as the contracting officer may consider necessary on account of conditions discovered during the prosecution of the work.

c. Prior to performing the work, the contractor shall check all drawings and shall immediately report to the contracting officer any errors or omissions discovered therein. Quantities stated in bills of material on Government drawings are approximate only. The contractor shall be responsible for furnishing the required quantity without change in unit price. All items to be furnished at lump sum prices shall be provided by the contractor complete and in good working order regardless of whether or not they are fully shown or listed on the contract drawings. The parts and details not fully shown on the drawings shall be drawn in detail by the contractor in accordance with best practice and four copies of each drawing shall be submitted to the contracting officer for approval. No material shall be furnished or work done pending approval of these drawings. Each sheet of drawings submitted for approval shall have in the lower right-hand corner just above the title a white space approximately 5" x 4", to be used for notation by the contracting officer. After approval

by the contracting officer, and before the corresponding work is commenced, one copy of each approved drawing will be furnished the contractor. All of these drawings shall form a part of this contract. Drawings furnished by the contractor for approval shall be made with ink on tracing cloth. Upon completion of the project, the contracting officer shall be furnished with "Van Dyke" negatives of the contractor's drawings corrected to show all revisions made during construction.

d. Ten sets of prints of all necessary drawings will be furnished the contractor without charge. Additional prints will be furnished upon request at the cost of printing.

1-05. Quantities. - The following estimate of quantities is given to serve as a basis for the comparison of bids and to determine the approximate consideration of the contract. Within the limits of available funds, the contractor will be required to perform the entire quantity of work necessary to complete the work specified in Paragraph 1-02 hereof, be it more or less than the amounts estimated herein:

Item No.	Designation	Unit	Quantity
1	Diversion and Care of River	job	-
2	Clearing and Grubbing	"	-
3	Common Stripping	cu.yds.	37,700
4	Common Excavation - General	" "	162,000
5A	Common Excavation - Access Road	" "	2,500
5B	Common Excavation - Access Road Structures	" "	400
6	Common Excavation - Cut-Off Trench	" "	6,500
7	Common Excavation - Borrow Area "A"	" "	140,000
8	Common Excavation - Borrow Area for Access Road	" "	13,000
9	Common Excavation - From Stock Piles	" "	55,000
10	Rock Excavation	" "	58,000
11	Line Drilling and Broaching	sq.ft.	18,200
12	Selected Impervious Fill	cu.yds.	65,000
13	Impervious Blanket Fill	" "	28,000
14A	Random Fill	" "	73,600
14B	Pervious Fill	" "	78,400
15	Gravel Bedding	" "	3,000
16	Fill (Unclassified) - Access Road	" "	14,500

Item No.	Designation	Unit	Quantity
17	Compacted Backfill	cu.yds.	1,000
18	Semi-Compacted Backfill	" "	5,600
19	Gravel for Roads	" "	2,000
20	Dumped Rock Fill	" "	38,000
21	Hand-placed riprap	" "	3,000
22	Grouted Stone Gutters	sq.yds.	350
23	Gravel Filled Drains	lin.ft.	1,000
24	12-Inch Corrugated Metal Pipe	" "	54
25	Core or Rotary Drilling In Rock or Concrete	" "	1,300
26	Ordinary Drilling	" "	850
27	Pressure Grouting	cu. ft.	1,300
28	Portland Cement	bbl.	17,600
29	Class "A" Concrete - Channel Lining and Gate Structure	cu.yds.	2,040
30	Class "B" Concrete - Outlet Works Retaining Walls	" "	390
31	Class "A" Concrete - Road and Bridge Structures	" "	170
32	Class "B" Concrete - Spillway Weir	" "	12,200
33	Steel Reinforcement	lbs.	164,000
34	Operating House Superstructure	job	-
35	Miscellaneous Structural Steel	lb.	9,000
36	Miscellaneous Iron and Steel	"	6,700
37	Miscellaneous Wrought Iron Pipe	"	5,800
38	Miscellaneous Black Steel Pipe	"	3,800
39	Miscellaneous Brass and Bronze	"	50
40	Copper Water Stops	"	160

Item No.	Designation	Unit	Quantity
41	Lighting and Power	job	-
42	Installing Gates and Accessories	lb.	200,000
43	Installing Conduit Linings	"	126,000
44	Furnishing and Installing Crane	job	-
45	Furnishing and Installing Gasoline-Electric Standby Unit	"	-
46	Highway Cable Fencing	lin.ft.	2,440
47	Highway Chain Link Fencing	" "	2,620
48A	Bituminous Macadam Road Surface on New Gravel Base	sq.yd.	7,700
48B	Bituminous Macadam Road Surface on Existing Railroad Ballast	" "	6,000
49	Tile Gage	job	1
50	Flag Pole	"	1

1-06. Physical data. - a. General. - Materials for constructing the earth dike are available in the vicinity of the work. Locations of borrow areas are shown on the drawings. Borings and test pits have been made in the vicinity of the proposed work with reasonable care and substantially at the places indicated on the drawings. Laboratory analyses have been made of the samples from many bore holes and test pits. Samples of materials taken from them, and records of laboratory analyses and results of other studies may be seen at the United States Engineer Office, Providence, Rhode Island. Samples and records available are believed to represent fairly the conditions at the site of the work, but it is expressly understood that the Government will not be responsible for any deduction, interpretation, or conclusions made by the contractor from his inspection of the available samples and records. These samples of materials and contract drawings represent all the pertinent information on subsurface exploration which the Government has made at the site.

b. Stream flow. - (1) The Millers River drains a total area of about 390 square miles, principally in Massachusetts, 176 square miles of which are above the dam site. The basin is oval, having a length of 32 miles with a maximum width of 23 miles, is generally hilly, and contains several lakes and ponds. The slope of the stream is fairly flat in the reservoir area. Above the reservoir the slope becomes steep, averaging approximately 22 feet per mile. The soil is generally sand and gravel, with large ground water storage capacity.

(2) There are seven U. S. Geological Survey stream gaging stations on the Millers River and its tributaries. One of these, located on the Millers River at Winchendon, Massachusetts (D.A. = 83.8 square miles) has been used to derive the hydrograph for the river at the dam site for the period from June 1916 to September 1938, inclusive. This continuous hydrograph, and the basis of its preparation, are shown in the set of drawings accompanying these specifications. The maximum flood of record, that of September 1938, had an estimated peak discharge of 16,000 c.f.s. at the dam site, or 91 c.f.s. per square mile, corresponding to a flood of approximately 600-year average frequency. The estimated peak discharge of 10-year average frequency is 4,000 second feet; of a 5-year frequency, 3,200 second feet.

c. Weather conditions. - The locality is subject to atmospheric temperatures ranging from minus 25 degrees to plus 103 degrees, with an annual mean of 47.5 degrees Fahrenheit. The mean annual precipitation is 39.42 inches. The average annual snowfall is 59 inches, of which about half occurs in January and February.

The U. S. Weather Bureau maintains a station at Fitchburg, Massachusetts, which is about 15 miles from the dam site. Mean monthly temperatures and precipitation for the station, over a period of 74 years, are given below:

	Mean Monthly Temperature (Degrees F.)	Mean Monthly Precipitation (Inches)
January	24.6	3.19
February	24.2	3.13
March	34.0	3.54
April	45.5	3.28
May	57.4	3.10
June	65.8	3.52
July	70.9	3.83
August	68.2	2.64
September	61.8	3.54
October	50.4	3.11
November	38.9	3.12
December	28.2	3.42

d. Electric power facilities. - Electric power can be supplied to the site of Birch Hill Dam by the Gardner Electric Light Company and the Winchendon Electric Light and Power Company with offices at Gardner and Winchendon, Massachusetts, respectively. There is a single-phase, 2300-volt line within a mile of the downstream side of the site belonging to the Gardner Electric Light Company. In order to get three-phase service it will be necessary to go to Baldwinsville a distance of 4 miles, to the source from which this line is energized. There is also a single-phase, 2300-volt line about a mile upstream from the dam site. This is the property of the Winchendon Electric Light and Power Company, and it would be necessary to go back to Centerville a distance of 5-1/2 miles to reach a three-phase source. If a large block of power is desired arrangements can be made with the New England Power Association which has a district office in Leominster, Massachusetts.

e. Transportation facilities. - (1) The nearest railroad station is located at South Royalston, Mass., on the Fitchburg Division of the Boston and Maine Railroad. The station and yard have adequate siding capacity and can accommodate a large number of cars. Sidings adjacent to the station can be reached by trucks. There is no unloading equipment. The contractor shall make his own investigation of and arrangements for siding capacity and other facilities required for unloading and storing of equipment and materials.

(2) The dam site may be reached from South Royalston by road on the right bank of the Millers River. This road turns off from the macadam surfaced road to Royalston and is gravel surfaced from the turn off to above the dam site. The contractor will be required to maintain traffic on this road during the first construction season. This road crosses the Millers River in South Royalston. The contractor shall provide his own construction roads and shall make his own investigations of all existing roads and capacities of existing bridges.

1-07. Commencement, prosecution and completion. - a. The contractor will be required to commence the work under the contract within ten (10) calendar days after date of receipt by him of notice to proceed, to prosecute the said work with faithfulness and energy, and complete the entire work within five hundred fifty (550) calendar days after said date of receipt of notice to proceed. The contractor shall complete the embankment shown on the drawings as the first season's work by November 1,1940 and shall complete the excavation, lining, and walls in the outlet works, complete construction of the gate structure to Elevation 839 feet m.s.l., construct the temporary upstream cofferdam to Elevation 820 feet m.s.l., and divert the river through the outlet works, by June 1, 1941. The permanent upstream and temporary downstream cofferdams shall be completed by July 1, 1941.

b. Liquidated damages. - In case of failure on the part of the contractor to complete the work or any portion thereof within the time determined and agreed upon for its completion plus any extensions duly granted under the terms of the contract, the contractor

along the ends and parallel to the

shall pay the Government as liquidated damages the following: For failure to complete the embankment required to be placed during the first season on the left bank of the river to Elevation 860 feet m.s.l. by November 1, 1940, the sum of fifty dollars ($50.00) for each calendar day of delay; for delay in completing the work sufficiently to permit diversion of the river through the outlet works by June 1, 1941 the sum of two hundred dollars ($200.00) for each calendar day of delay; for delay in completing permanent upstream and temporary downstream cofferdams to Elevation 832 feet and Elevation 823 feet respectively by July 1, 1941 no liquidated damages shall be paid by the contractor but the contractor shall be held liable for any damage to the permanent embankment between these cofferdams not caused by overtopping; for delay in completing the entire work under the contract within five hundred fifty (550) calendar days, the sum of two hundred dollars ($200.00) for each calendar day beyond the date fixed or stipulated in subparagraph a above until all work is completed and accepted.

1-08. Sundays, holidays, and nights. - No work shall be done on Sundays or on days declared by Congress as holidays for per diem employees of the United States except in cases of emergency, and then only with the written consent of the contracting officer. Work may be done at night when authorized in writing by the contracting officer.

1-09. Progress, organization, and plant. - a. The contractor shall employ at all times, an ample force of men with proper experience in their respective assignments, and provide equipment and a construction plant properly adapted to the work, and of sufficient capacity and efficiency to accomplish the work in a safe and workmanlike manner within the time specified in Paragraph 1-07. All plant and equipment shall be maintained in good working order, and provision shall be made for immediately emergency repairs. The contracting officer may order the removal and require replacement of any unsatisfactory plant or equipment. No reduction in the capacity of the plant employed on the work shall be made, except under written permission of the contracting officer. The measure of "Capacity of the Plant" shall be its actual performance on the work to which these specifications apply. It is understood that award of this contract shall not be construed as a guarantee by the Government that the plant and equipment listed by the contractor in the bid form is adequate for the performance of the work.

b. Should the contractor fail to maintain a rate of progress which will insure completion of the work within the time specified in Paragraph 1-07, the contracting officer may require that additional men, equipment or plant be placed on the work, or a reorganization of plant layout be effected in order that the work be brought up to schedule and maintained there. Should the contractor refuse or neglect to comply with these requirements to the satisfaction of the contracting officer, the contracting officer will proceed under the provisions of Article 9 of the contract.

1-10. Payments. - a. The River and Harbor Act approved September 22, 1922, contains the following provisions:

> That any work of improvement herein adopted and any public work on canals, rivers, and harbors adopted by Congress may be prosecuted by direct appropriations, by continuing contracts, or by both direct appropriations and continuing contracts.

b. Under the contract to be entered into under these specifications, such work as may be done after June 30, 1940 or in excess of the amount for which funds are available for payment as herein set forth, will be continued with funds to be hereafter appropriated.

c. From funds heretofore appropriated by the Acts of June 11, 1938 and June 28, 1939, for the maintenance and improvement of existing improvements of river and harbor works, the sum of $1,302,000 has been initially allotted for this project. Of this sum, the amount of about $300,000 is available for payments of the contractors' estimates.

d. If at any time it becomes apparent to the contracting officer that the remaining balance of this allotment and reservation is in excess of the amount required to meet all payments due and to become due to the contractor, because of work performed and to be performed until June 30, 1940 and for all supervisory, collateral, and incidental expenses in connection therewith until that date, the right is reserved after due notice to the contractor to reduce said allotment and reservation by the amount of such excess.

e. If the rate of progress of the work is such that it becomes apparent to the contracting officer that the remaining balance of the allotment and reservation is less than that required to meet all payments due and to become due to the contractor because of work performed and to be performed until June 30, 1940 and for all supervisory, collateral, and incidental expenses in connection therewith until that date, the Government may allot and reserve additional funds for payments under this contract if there be funds available for such purpose. The contractor will be advised of any additional allotment so made.

f. It is expected that prior to June 30, 1940, Congress will make additional appropriations applicable to work under this contract, but it must be distinctly understood and agreed that the Government is in no case to be made liable for damages in connection with this contract on account of delay in payments on same due to a lack of available funds. Should it become apparent that the available funds will be exhausted before additional funds are appropriated, the contracting officer will give 30 days' written notice to the contractor that work may be suspended; but, if the contractor so elects, he may continue work under the conditions and restrictions of the specifications, after the time set by such notice, so long as there are funds for inspection and superintendence, with the

understanding, however, that no payment will be made for such work until additional funds shall have been provided in sufficient amount. When funds again become available, the contractor will be notified accordingly. Should work be thus suspended, additional time for completion will be allowed equal to the period during which work is necessarily so suspended, as determined by the dates specified in the above notices (see also Paragraph 1-07 a).

g. So long as funds are available, payments will be made monthly in accordance with Article 16 of the contract for work executed and completed as specified or otherwise required, and not included in any prior estimate, subject to the conditions stipulated in these specifications for estimating for partial payments.

h. The procedure above described will be repeated as often as may be necessary on account of the exhaustion of available funds and the necessity of awaiting the appropriation of additional funds by Congress.

i. Should Congress fail to provide the expected additional funds during its regular session, the contract may be terminated and considered to be completed, at the option of the contractor, without prejudice to him, at any time not later than 30 days after payments are discontinued, or if payments have been previously discontinued, not later than 30 days after the passage of the act which would ordinarily carry an appropriation for continuing the work, or after the adjournment of Congress without passing such act.

j. In event of termination of the contract prior to its completion, under the terms of Paragraph 1-10 i, all balances due the contractor under the terms of the contract for work authorized and acceptably executed prior to date of said termination of contract will be paid, including retained percentage and less any proper deductions. The Government will take over, at cost to the contractor, all materials to be incorporated in the structures for which partial payment upon delivery is authorized by the specifications and procurement of which was authorized in writing by the contracting officer, deductions being made for any damaged or unsatisfactory material and for any costs of protection incurred by the Government.

1-11. Work covered by contract price. - The contractor shall, under his contract prices, furnish and pay for all material, equipment and labor, and all permanent, temporary, and incidental work, furnish all accessories, and do everything that may be necessary to carry out the work specified in good faith, which contemplates everything specified completed, in good working order, of good materials with accurate workmanship, skillfully fitted and properly connected and put together (see Paragraph 1-13).

1-12. Tax adjustments. - The contract price will be considered to include all Federal, State and local taxes imposed prior to the date of

opening bids and applicable to the undertaking. If any privilege, sales, gross receipt or other tax (exclusive of taxes on net income or undistributed profits) applicable to the undertaking and payable directly by the contractor, is imposed or changed after the date of opening bids by Federal or State enactment, then the contract price will be increased or decreased accordingly and any amount due or chargeable against the contractor as a result thereof will be adjusted on payment vouchers as separate items.

1-13. Materials to be furnished by the contractor. - The contractor will be required to furnish all materials and equipment necessary to complete the work to be done under these specifications, except for the materials and equipment to be furnished by the Government as provided in Paragraph 1-14. The equipment furnished by the contractor and installed in the work covered by these specifications shall conform to the drawings and specifications, and shall also conform to the drawings and data sheets furnished by the contractor and approved by the contracting officer. The cost of unloading and loading, handling, hauling, storing, and caring for materials and equipment furnished by the contractor shall be included in the contract prices for the work to which the materials pertain. All materials, supplies, and articles delivered at the site shall be adequately housed or otherwise protected against deterioration and damage.

1-14. Materials and equipment to be furnished by the Government. - a. The Government will furnish the following materials and equipment:

(1) Four service gates, complete with frames, guides, motor-operated screw hoists and accessories.

(2) One emergency gate, complete four sets of frames, guides, and accessories.

(3) Four sets of conduit linings.

(4) One bronze plaque (see Paragraph 11-01 b)

b. Delivery. - The contractor shall give the contracting officer 30 days' written notice of the quantities, designation, and desired delivery dates of materials and equipment required (see Paragraph 14-02). The Government will not be liable for any expenses or delay caused the contractor by delayed deliveries, except as provided under Article 9 of the contract. The equipment and materials to be furnished by the Government will be delivered to the contractor f.o.b. railroad cars at South Royalston, Massachusetts, or f.o.b. trucks at the site of the work, at the option of the contracting officer.

c. Unloading and transportation. - The contractor shall promptly unload the materials and equipment from railroad cars and trucks, and will be held responsible for any demurrage charges incurred due to failure to unload promptly the cars or trucks. The contractor

shall transport the materials and equipment from the point of delivery to the site of the work and shall store them in a suitable warehouse until they are incorporated in the work. The cost of unloading, handling, hauling, storage, and caring for materials and equipment furnished by the Government shall be included in the prices bid for installing the several items of materials and equipment.

d. Shortage. - The contractor shall check the quantity and condition of all materials and equipment when delivered to him and in case there is any damage to, or shortage of, material or equipment, he shall so report to the contracting officer, in writing, within 24 hours.

1-15. Order of work. - The work shall be carried on at such places and in such order of precedence as may be found necessary by the contracting officer and in accordance with Paragraph 1-07. The contractor shall submit, for approval of the contracting officer, his proposed program in writing giving the sequence of construction operations contemplated. The location and limits of the work to be done will be plainly indicated by stakes, lines, marks or otherwise as established by the contracting officer or his agents.

1-16. Stream turbidity. - The contractor shall conduct his operations so that the turbidity of the water in the Millers River will not be increased to a degree which, in the opinion of the contracting officer, is detrimental to its use in industrial processes.

1-17. Damage. - Damage to Government property due to the failure of the contractor to take reasonable precautions, and all loss or deterioration of, or damage to any of the work by flood, accident or exposure prior to final acceptance of the work, shall be made good by the contractor without expense to the Government; except that the Government will compensate the contractor for repairs to the permanent work, if damaged by floods overtopping the coffordams, built and maintained as specified in Paragraph 2-03.

1-18. Patents. - The contractor shall hold and save the Government, its officers, agents, and employees harmless from liability of any nature or kind, including costs and expenses, for or on account of any patented or unpatented process, or invention, article, or appliance manufactured or used in the performance of this contract, including its use by the Government.

1-19. Grounds and rights of way. - a. Grounds and rights of way, needed for the work to be done under these specifications, will be furnished by the Government. The Government shall not be held liable for any delay in furnishing the grojnds or rights of way, but in case such delay retards the operations of the contract, the contracting officer will grant an extension of time for the completion of the work equal to the time of the delay (see Paragraph 1-07). The contractor will have the privilege of using the Government controlled land at the site, not

otherwise reserved by the contracting officer; provided, that plans for all construction, storage, or other operations proposed thereon by the contractor are submitted for approval of the contracting officer, prior to the occupation of such areas.

b. The County of Worcester will close the road through the dam site.

c. The Boston and Maine Railroad along the left bank of the river will be relocated by other agencies early in the second season of embankment construction. The contractor shall carry on his construction operations in such a manner as not to interfere with traffic on this railroad prior to its relocation. The contractor, without expense to the Government, at any time during the progress of the work and when space is needed for other purposes, shall vacate promptly and clean up any part of the grounds allotted to or in use by him, when directed to do so by the contracting officer.

1-20. Temporary fences. - The contractor shall be responsible for the protection of animals and other property of adjacent owners so far as affected by his operations and shall build and maintain such temporary fences as may be required to permit the reasonable use of such adjacent property. No separate payment will be made for such fences.

1-21. Removal of rubbish. - The contractor shall keep the site free from rubbish. Suitable repositories for receiving refuse from the camp, kitchen, or grounds, shall be provided, and the rubbish shall be removed and disposed of as directed by the contracting officer. At the conclusion of the work, the site shall be cleaned up and all rubbish and unused materials shall be disposed of in accordance with the provisions of Paragraph 18-06.

1-22. Obstruction and danger lights. - In the contractor's use of the highways, for the work to be done under these specifications, he shall conduct his operations as approved by the contracting officer and in accordance with state and local laws and regulations. The contractor will be required to place effective barricades on all intercepted roads or highways. All barricades and obstructions shall be provided with lights at night, and all such lights shall be kept burning between sunset and sunrise. Such barricades and lights shall conform to the local and state laws. The contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient red lights, danger signals, and signs about the site, for the protection of the works and safety of the public. The expense of these and other safety precautions shall be borne by the contractor.

1-23. Inspection and supervision. - a. General. - The work will be conducted under the general direction of the contracting officer, and will be inspected by inspectors appointed by him who will enforce a strict compliance with the terms of the contract. The contracting

officer will furnish on request of the contractor, all location and limit marks reasonably necessary as provided in Paragraph 1-25. The inspectors will keep a record of work done, and see that the location and limit marks are kept in proper order; work done without proper inspection may not be paid for. The presence of an inspector shall not relieve the contractor of his responsibility for the superintendence required in the proper execution of the work (see Article 8 of the contract). Tests to determine the quality and fitness of material used and work done under these specifications will be made as indicated under that part of the specifications pertinent to the particular kind of work, and as stated in Paragraph 1-40.

b. Facilities to be furnished. - (1) The contractor shall furnish promptly, in accordance with Article 6 of the contract, all facilities, labor, and materials necessary for the safe and convenient inspection and tests that may be required by the contracting officer.

(2) The contractor shall furnish an appropriate room having at least 140 square feet of floor space at his concrete mixing plant for a Government laboratory, to be used for making field tests including the moisture content of aggregates and such other field tests as are prescribed in these specifications under Section IX and for temporary storage of concrete specimens. The room shall be protected from the weather, properly lighted, and heated, all of which together with the location and capacity will be subject to the approval of the contracting officer. The contractor shall provide electricity in accordance with Paragraph 1-37.

(3) No separate payment will be made to the contractor for providing these facilities. Should the contractor refuse, neglect, or delay compliance with the requirements concerning facilities for inspection, the specific facilities may be furnished and maintained by the Government, and the cost therefor will be deducted from any amounts due or to become due the contractor.

c. It is hereby understood and agreed that any instructions or decisions by a superior officer through the contracting officer are to be considered instructions or decisions of the contracting officer in all cases under the terms of the contract where decision rests with the contracting officer.

1-24. Datum and bench marks. - The plane of reference used in these specifications and on the drawings is mean sea level datum. Elevations in feet as specified and as shown on the drawings are to be determined from bench marks located at the site of the work; the locations, descriptions, and elevations (in feet) of which are as follows:

Description of Bench Marks
at
Birch Hill Dam Site

Mass. Geodetic Survey B.M. Disc AH 30 El. 865.305 m.s.l.

In South Royalston; in a field on north side of High Street; 163 feet north of the north corner of South Royalston grammar school, and 90 feet north of the north corner of the Congregational Church. A Mass. Dept. of Public Works standard bench mark disk, set in the highest point of a large boulder. June 1935.

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Mass. Geodetic Survey T.B.M. 431 El. 832.760 m.s.l.

One mile east of South Royalston; in a ledge outcrop 360 feet east of the Boston and Maine Railroad (Fitchburg Division), Culvert #47.38, and 8 feet south of south rail. A copper plug. June 1935.

1-25. Lines and grades. - a. The contractor shall keep the contracting officer informed a reasonable length of time in advance of the time and places at which he intends to do work in order that lines and grades may be given, necessary measurements for record and payment made and progress photographs taken with a minimum of inconvenience to the contracting officer or of delay to the contractor, and the contractor shall have no claim for damages or extension of time on account of delays in the giving of lines and grades or destruction of such marks and the consequent necessity for replacement. Whenever the contracting officer finds it necessary to carry on his operations on Sundays, legal holidays or at other times when the work of the contractor is not in progress, the contractor shall furnish all necessary service and assistance. No direct compensation will be made for the cost to the contractor for any of the work or delay occasioned by giving lines and grades or making other necessary measurements or by inspection, but compensation shall be considered as having been included in the contract prices for Items 1 to 50, inclusive.

b. All lines and grades will be given by the Government inspectors as authorized representatives of the contracting officer, but the contractor shall provide at his own expense such temporary structures and such materials and give such assistance as may be required by the contracting officer and the marks given shall be carefully preserved.

1-26. Interpretation of specifications. - The contracting officer shall decide all questions which may arise as to the performance, quantity, quality, acceptability, fitness, and rate of progress of the several kinds of work to be done or materials to be furnished under this contract. He shall decide all questions which may arise as to the inter-

pretation of the specifications and of drawings used and as to the fulfillment of this contract on the part of the contractor, and as to defects in the contractor's work. The determination and decision of the contracting officer shall be final, subject to appeal as provided for in Article 15 of the contract.

1-27. Water supply. - The contractor shall provide, at convenient points, ample supplies of water of proper quality for all the operations required under this contract, including the water required for the rolled fill construction. The contractor will be allowed to pump water from the Millers River for use in the construction operations. Proper piping systems shall be installed, maintained and extended from time to time to distribute water to the various portions of the work where it is needed, including a satisfactory supply to the Government field office and contractor's camp. Wherever necessary, the water shall be under sufficient pressure for construction purposes.

1-28. Use of explosives. - The contractor shall use the utmost care in the use of explosives necessary for the prosecution of the work, so as not to endanger life or property. All blasting operations shall be conducted by experienced men only. The handling and use of explosives shall be done strictly in accordance with the latest methods and rulings to insure safety; in accordance with the specifications issued by the U. S. Bureau of Mines; and in compliance with the local and state laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be stored and transported in a secure manner, and in accordance with local and state laws; all such storage places shall be marked clearly "DANGEROUS - EXPLOSIVES," and shall be in care of competent watchmen at all times. In no case shall caps or other detonators be stored or transported with dynamite or other explosives. The location of magazines for the storage of explosives and for the separate storage of detonators shall be subject to the approval of the contracting officer.

1-29. Contractor's camps, intoxicating liquors. - a. Subject to the approval of the contracting officer, the contractor may construct, upon the property controlled by the Government at approved locations, buildings for housing his employees, storing his materials and for other purposes pertinent to the satisfactory completion of the work. Plans showing the camp layout and sanitary provisions shall be approved before erection is commenced. The contractor shall maintain good order and discipline in his camps and to that end shall employ such watchmen or other persons as may be required. Upon completion of the work, but not sooner unless so ordered or permitted, buildings and other camp structures, that the contracting officer may permit, shall be removed. Buildings, not ordered or permitted to be removed upon completion of the work, shall become the property of the Government.

b. The contractor shall not sell intoxicating liquors on or about the works, and shall not permit their sale, introduction or use

upon the works, embraced by this contract, nor upon any of the grounds occupied or controlled by him.

1-30. Standard stock products. - All material, supplies and articles furnished shall, wherever so specified and otherwise wherever practicable, be the standard stock products of recognized reputable manufacturers. The standard stock products of manufacturers other than those specified will be accepted if, in the opinion of the contracting officer, they are equal in strength, durability, usefulness and convenience for the purpose intended. (See Article 7 of the contract.) Any changes required in the details and dimensions shown on the drawings for the substitution of standard stock products, other than those provided for, shall be properly made as approved by the contracting officer, and at the expense of the contractor. (See Paragraph 1-04 c.)

1-31. Safety requirements. - a. The contractor shall make all necessary provisions to protect the public safety, and to maintain and protect existing structures of whatever kind, and shall repair all damages done to such structures. He shall give ample notification to the proper officials of any city or town and of any public utility or other corporation before entering upon their respective public ways or rights of way to perform the required work of construction. Such construction shall conform to the customary regulations and requirements of said officials or corporations. The contractor shall give all notices, take out all permits, and pay all such charges, fees, water and other rates that may be necessary in the carrying out of the work.

b. The contractor shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the contract. He shall comply with all applicable Federal and state laws under which he is operating, including those concerning the inspection of boilers and other equipment, the licensing of engineers, welders and other employees.

c. The contractor shall conduct the work with due regard to adequate safety and sanitary requirements and shall maintain his plant and equipment in safe condition. He shall conform to current safety engineering practices as set forth in the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America; the publications of the National Safety Council, and with all applicable state or local safety and sanitary laws, regulations and ordinances.

d. The contracting officer will require such safety and sanitary measures to be taken as the nature of the work and the conditions under which it is to be performed, demand. Such measures shall include:

(1) The provision of adequate extinguishers or fire-fighting apparatus in and about all buildings and plant erected or used at the site of the work;

(2) Adequate first aid and life-saving equipment;

(3) Adequate illumination during night operations;

(4) Instruction in accident prevention to reach all employees;

(5) Such machinery guards, safe walkways, scaffolds, ladders, bridges, gang-planks, and other safety devices, equipment and apparel as are necessary to prevent accident or injuries.

e. The contractor shall promptly report to the contracting officer in form prescribed by him all accidents occurring at the site of the work.

f. The contracting officer will notify the contractor in writing of any non-compliance with the foregoing provisions and the corrective action to be taken. If the contractor fails or refuses to comply promptly the contracting officer may issue a stop order suspending all or any part of the work. Such stop order will be sent by registered mail to the contractor at the site of the work and shall be accepted by him as sufficient notice thereof. Work shall thereupon be suspended as directed. When satisfactory corrective action is taken, a resumption order will be issued. No part of the time lost due to any such stop order shall be made the subject of a claim by the contractor for extension of time or for extra compensation.

1-32. Interference with other contractors. - The contractor shall be subject to Article 13 of the contract regarding interference with materials, appliances or employees of the Government or of any other contractor who may have work at the site. As far as practicable, all contractors shall have equal rights to the use of all roads and grounds. In case of disagreement regarding such use, the decision of the contracting officer shall govern, subject to appeal under Article 15 of the contract.

1-33. Access to work. - The contracting officer, his authorized representative, and other duly authorized agents and employees of the Government may at all times enter upon the work and premises used by the contractor, or into his works, or shops. The contractor shall provide safe and proper facilities for such entrance and for the inspection of materials and workmanship.

1-34. Purchase of supplies and materials. - a. Preference for domestic articles. - (1) Because the materials listed below or the materials from which they are manufactured are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified (subject to the requirements of the specifications) is authorized without regard to the country of origin.

Platinum	Nickel	Asbestos
Chromium	Rubber	China wood oil (tung oil)
Cork	Teakwood	Balsa wood
Jute	Sisal	English ball clay
Kauri gum	Silk	English china clay
Lac	Tin	Natural copper nickel alloy (monel metal)

(2) Articles, materials, or supplies, manufactured in the United States and containing mercury, antimony, tungsten, or mica of foreign origin may be used (subject to the requirements of the specifications) in the work herein specified, because such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be, in the United States.

b. Purchasing procedure. - Two copies of all purchase orders showing firm names and addresses, and of all shipping bills or memoranda of shipments received showing car initials and numbers, when shipped by railroad, shall be furnished promptly to the contracting officer. Such orders, shipping bills or memoranda shall clearly indicate weights, and shall be so worded or marked that each item, piece or member can be definitely identified on the drawings.

1-35. Minor modifications. - The right is reserved to make such minor changes in the execution of the work to be done under these specifications as, in the judgment of the contracting officer, may be necessary or expedient to carry out the intent of the contract; provided that the unit cost to the contractor of doing the work shall not be increased thereby, and no increase in unit price over the contract rate will be paid to the contractor on account of such changes.

1-36. Protests and appeals. - The Chief of Engineers has been designated by the Secretary of War as his duly authorized representative to make final decision, and to take other action where the terms of the contract require that such decision or action shall rest with "the head of the department concerned or his duly authorized representative." If the contractor considers any work required of him to be outside the requirements of the contract, or if he considers unfair any action or ruling of the inspectors or contracting officer, he shall ask for written instruction or decision from the contracting officer immediately. Any protest based upon such instructions or decision, or claim otherwise arising under the contract, including a request for extension of time under Article 9 of the contract, shall be submitted to the contracting officer within the period specified in the contract. If the contractor is not satisfied with the ruling of the contracting officer he may, where appeal is stipulated in the contract, make written appeal to the Chief of Engineers. Such appeals, containing all the facts and circumstances upon which the contractor bases his claim for relief, shall be addressed to the Chief of Engineers, United States Army, and presented to the contracting officer for transmittal within the time provided therefor in the contract.

1-37. Electric power to be furnished by the contractor. - a. The contractor shall make arrangements for, shall pay for, and furnish all necessary power to carry on the work, including sufficient power for lighting and other miscellaneous uses in buildings furnished by the contractor for Government use during the life of the contract. No separate payment will be made to the contractor for the power furnished.

b. The Government will require different service at the dam site from that now available to operate the gates and machinery to be installed in the operating house. The Government will not require the contractor to provide this service.

1-38. Rate of wages. - a. In accordance with Article 17 of the contract, the minimum wages shown in the following schedule, as approved by the United States Department of Labor, shall be the minimum rates of wages to be paid by the contractor for work under this contract. Corresponding rates for occupations not listed below will be furnished upon application by the contractor.

Designation	Wage Rate - Hourly
Air tool operator (jackhammer)	$ .65
Brickmason	1.25
Blaster (headman)	1.00
Blacksmith	1.20
Boilermaker	1.50
Boilermaker helpers	1.37-1/2
Carpenter	.90
Cement finisher	1.25
Cement gun nozzleman	1.00
Concrete puddler (includes screeder and vibrator)	.65
Diver	1.50
Diver tender	.75
Electrician	1.12-1/2
Finisher (rough concrete)	.90
Fireman	.75
Form builder	.90
Glazier	1.37-1/2
Handyman, repair or maintenance	.75
Hod carrier (mason tender)	.75
Ironworker (structural)	1.37-1/2
Laborer, unskilled	.50
Machinist	1.25
Mechanic	1.00
Mortar mixer	.75
Oiler	.75
Operator of power equipment:	
Cableway	1.25
Crane	1.50

Designation	Wage Rate - Hourly
Operator of power equipment (cont'd.)	
Crusher	$ 1.00
Derrick	1.50
Dragline	1.50
Hoist	1.25
Pile driver	1.50
Power shovel (steam or gas)	1.50
Roller (steam or gas)	1.00
Scraper	1.00
Steam locomotive	1.00
Stationary power plant	1.00
Tower excavator	1.25
Trenching machine	1.50
Operator of small equipment:	
Bulldozer, over 40 h.p.	1.00
" , 40 h.p. or less	.75
Compressor (400 cu. ft. displacement or over)	.87-1/2
" (under 400 cu. ft. displacement)	.75
Concrete mixer (5 bag and over)	1.25
" " (under 5 bag)	.75
Grader, blade	.75
Grouting machine	.75
Power saw	.90
Pump	.75
Tractor: 40 h.p. or less	.75
over 40 h.p.	1.00
Trucks: less than 1-1/2 tons	.50
1-1/2 tons and over	.60
Painter	.80
Pile driving man	1.27-1/2
Pipe layer	.65
Plumber	1.00
Powderman monkey	.60
Reinforcing rod placer	1.12-1/2
Rigger (machinery erectors)	1.37-1/2
Sheet metal worker (roofer)	1.37-1/2
Steam fitter	1.00
Stone mason	1.25
Teamster	.60
Tool dresser	1.00
Tunnel miner	.90
Well drill operator	.87-1/2
Welder, acetylene and electric	1.20

b. Any class of laborers and mechanics not listed above, which will be employed on the work, will be classified or reclassified by the contracting officer to conform to the foregoing schedule. In the event of disagreement between the contracting officer and the contractor as to such classification or reclassification, the question, accompanied by the recommendation of the contracting officer, will be referred to the United States Department of Labor for final determination.

c. The above list of wages shall be posted by the contractor in a conspicuous place on the work.

1-39. Reports to Department of Labor. - The contractor shall report, and shall cause all subcontractors to report in like manner, within 5 days after the close of each calendar month, on forms to be furnished by the Department of Labor, the number of persons on their respective pay rolls, the aggregate amount of such pay rolls, the man-hours worked, and the total expenditures for materials. He shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable, provided that the foregoing shall be applicable only to work at the site of the construction project.

1-40. Standard tests, qualities and guarantees. - a. All materials, supplies and parts and assemblies thereof, entering into the work to be done under these specifications, shall be tested as specified, or otherwise required, in conformity with the best modern approved methods for the particular type and class of work.

b. Unless waived in writing by the contracting officer, all tests and trials shall be made in the presence of a duly authorized representative of the contracting officer. When the presence of the inspector is so waived, sworn statements, in duplicate, of the tests made and the results thereof, shall be furnished to the contracting officer by the contractor.

c. Costs of all tests and trials, excepting the expense of the Government inspector and the cost of tests on cement, concrete aggregates, concrete cylinders, and embankment materials, shall be borne by the contractor and shall be included in the contract price. (See Paragraph 9-11).

d. All materials, parts and equipment shall be of the highest grade, free from defects and imperfections, of recent manufacture, new and unused. Workmanship shall be of the highest grade and in accordance with the best modern standard practice.

1-41. Welding and welders. - a. Welders who have not been certified within two years of date of signing the contract will be required to pass successfully the tests as prescribed by the American Bureau of Welding or the Bureau of Navigation and Steamboat Inspection, before being assigned to production work. The contractor shall bear the expense of conducting these tests, and shall certify, by name, to the contracting officer, welders who have successfully passed the prescribed tests. The contractor shall require any welder to repeat these tests when, in the opinion of the contracting officer or his representative, the work of the welder indicates a reasonable doubt of his efficiency. In such cases the welder shall be recertified as above if he successfully passes the retest; otherwise he shall be disqualified until he has successfully passed a retest.

b. The assembly of all joints shall be such as to permit good welding. Welding shall not be used to close openings larger than those required for proper assembly.

1-42. Final acceptance and payment. - As soon as practicable after the completion of the entire work, it will be examined by the contracting officer, and all important machinery and operating parts will be operated through their range of operation, and if found to conform to the requirements of the contract and specifications will be accepted. If the entire project is found to comply fully with the requirements of the contract, it will be accepted, and final payment will be made in accordance with Article 16 of the contract.

1-43. Approval. - This contract will be subject to the written approval of the Division Engineer, North Atlantic Division, and shall not be binding until so approved.

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SECTION II. DIVERSION AND CARE OF RIVER (Item 1)

2-01. Work included. - a. The contractor shall protect the permanent construction and divert the Millers River as provided in Paragraph 1-16 and 2-01 b and, unless otherwise authorized by the contracting officer, shall construct all permanent work under the contract in areas free from water. The contractor shall keep the diversion works free from obstruction by ice or debris. (See Paragraph 1-16.)

b. The contractor, until the completion of his contract, shall satisfactorily control and direct the flow of the Millers River and any tributaries at or near the site of the work, so that no part of the permanent construction described in these specifications or shown on the drawings shall be damaged. Diversion of the Millers River shall be accomplished through the outlet works in the north abutment of the dam after the construction of the gate structure and all necessary appurtenances, have been satisfactorily constructed to the elevations required in Paragraph 1-07 and such diversion authorized in writing by the contracting officer. Prior to the authorized diversion, the control of the river shall consist mainly of keeping the river channel free from debris and allowing the river to flow past the site unimpeded.

2-02. Diversion. - The rolled fill embankment as shown on the drawings between the left bank of the Millers River and the Boston and Maine Railroad tracks will be constructed to a minimum elevation of 832 feet mean sea level during the first season, prior to the completion of the approach channel, outlet works, and outlet channel. Dumped rock fill shall be placed along the toes of the embankment as shown on the drawings and along the ends and parallel to the river and the railroad, and brought up with the embankment. The rock fill on the ends of the embankment parallel and adjacent to the river and the railroad is for temporary protection and need not be built in accordance with the provisions of Paragraph 7-01, but shall be built to meet the approval of the contracting officer. After permanent diversion, any dumped rock or other protective material placed within the embankment area for temporary protection shall be removed and used in the permanent work or disposed of in designated spoil areas as directed by the contracting officer.

2-03. Cofferdams for embankment. - a. General. - After the gate structure and approach and outlet channels and all other work affected by permanent diversion, have been completed to the extent deemed necessary by the contracting officer, and upon written instructions, the contractor shall divert the Millers River through the permanent outlet works by construction of the temporary upstream cofferdam to Elevation 820.

b. Temporary cofferdams. - The temporary upstream diversion cofferdam shall be constructed in the location shown on the drawings as an earth dike with top Elevation 820 feet mean sea level. Materials from

the required excavation, unsuitable for the dam embankment may be used in the construction of the cofferdams as directed, except for those portions which fall within the limits of the dam embankment, which portions shall be constructed of approved materials in accordance with the drawings and specifications for the dam embankment. After diversion the contractor shall construct the downstream cofferdam as an earth dike at the location shown on the drawings to top Elevation 823.

c. Permanent cofferdams. - Immediately following diversion of the stream and completion of the downstream cofferdam the contractor shall prepare the foundation for the permanent cofferdams and construct these cofferdams to top Elevation 832 feet mean sea level at the locations shown on the drawings. These cofferdams shall be of material suitable for the dam embankment and shall be constructed as specified in Paragraphs 5-04, 5-05, and 5-06.

d. Removal. - When the dam embankment has reached a state of completion acceptable to the contracting officer, temporary cofferdams shall be removed or graded to elevations as shown on the drawings or directed by the contracting officer.

e. Responsibility. - All cofferdams shall be built and maintained to the effective elevations specified and to such sections as may be adequate. The contractor shall be responsible for the adequacy of all the cofferdams. The contractor shall be responsible for any damage resulting from failure or washing out of cofferdams for any reason, provided that the damage is not caused by overtopping of the cofferdams (see Paragraph 2-04).

2-04. Overtopping. - If the water rises and overtops the diversion cofferdams or levees that have been satisfactorily constructed and maintained to the effective elevations shown on the drawings, resulting in injury to the permanent work within the protected area, the contractor shall repair all damages as ordered by the contracting officer. Payment of the cost of such repairs to the permanent work will be made in accordance with the provisions of Paragraph 2-05 c.

2-05. Payment. - a. Except as otherwise provided the contract price for Item 1 shall include payment for diversion and care of river during construction, the construction, maintenance, rebuilding in case of destruction, and removal of the temporary diversion cofferdams, and maintenance of unobstructed flow through the diversion channel. The contract price for Item 1 shall also include payment for placing and removing temporary rock fills at the ends of the initial portion of the embankment and any other temporary protective materials; and shall include all other work required in the diversion and care of the stream during construction not specifically mentioned, including removal and disposal of all debris and trash deposited by floods, maintenance of unobstructed flow through the diversion channel and pumping required to unwater the construction area within the cofferdams.

b. Estimates for partial payments for this work will be made as follows: twenty-five percent (25%) of the contract price for Item 1 when the river has been diverted and the temporary upstream cofferdam completed to Elevation 820 feet mean sea level; an additional twenty-five percent (25%) when the permanent coffordams have been completed to Elevation 832 feet mean sea level; and the remaining fifty percent (50%) when the dam embankment has been completed to Elevation 832 feet mean sea level and the protecting works have been removed in accordance with Paragraph 2-03 d.

c. Payment for repairing all damages to permanent work as ordered by the contracting officer will be made at the contract prices for the respective items of work, provided that the damage was not due to any fault or negligence of the contractor. Any damage to the temporary cofferdams, or any temporary protective work shall be replaced by the contractor at his own expense. The contractor shall be responsible for the maintenance and replacement of the diversion cofferdams until the dam embankment has been completed to Elevation 832 feet mean sea level, and shall repair without cost to the Government, any damage to the permanent work that may result from his failure to properly maintain the above protective structures.

d. Since the upstream cofferdams to Elevation 832 (see Paragraph 2-03 c) are a part of the permanent embankment described in Section V for Items 12, 13 and 14, payment for constructing these cofferdams will be made at the contract unit prices for Items 12, 13 and 14, as applicable, and payment will be allowed for reconstruction in case of washouts, subject to the provisions of Paragraphs 2-04 and 2-05 c.

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SECTION III. CLEARING AND GRUBBING (Item 2).

3-01. Work included. - The major portion of the clearing has been done by the Government but wherever encountered the contractor shall clear and dispose of all trees, brush, buildings, fences, and rubbish from within the limits of the spillway approach, spillway chute, main dam, inlet and outlet works, including the intake and outlet channels, roads, spoil areas, and elsewhere as directed by the contracting officer. The contractor shall grub and dispose of all stumps, roots, and other objectionable materials from the areas within the limits of the foundations of required embankments, including a 10-foot strip measured horizontally beyond and contiguous to the toes or limit lines of the embankment. Clearing or grubbing in borrow areas or for construction roads or other purposes of the contractor will not be included in Item 2.

3-02. Description. - a. The total of the areas to be cleared will not exceed 2 acres. The total areas to be grubbed will not exceed 12 acres. All tap and lateral roots and other growth within the foundation area of the embankment that measure over two inches in diameter shall be grubbed out for a depth of three feet below the ground surface. In the embankment foundation area, stumps shall be dug out or removed by stump-pulling machines or other mechanical devices and not by blasting. Holes left by grubbing shall be satisfactorily filled with suitable material. (See Paragraph 5-05 b).

b. The contractor shall remove and dispose of trees, stumps, brush, roots, and any other objectionable material or structures from within the limits of the access road. No living trees existing outside of the roadway lines shall be cut, unless directed by the contracting officer. The branches of all such trees that are left standing within the right-of-way shall be carefully trimmed. All trees and stumps removed in excavation for the roadway shall be cut off and grubbed out so there shall be no stumps or roots within 12 inches of the subgrade surface. Where subgrade embankment is to be made clearing and grubbing shall conform to the provisions of Paragraph 3-02 a and b.

3-03. Disposal of materials. - Acceptable materials obtained by clearing operations may be used in the work. Timber and cord wood obtained from clearing operations and any buildings ordered removed shall become the property of the contractor who shall satisfactorily dispose of these items. The contractor shall burn or otherwise satisfactorily dispose of all trees, brush, and rubbish.

3-04. Payment. - Payment will be made at the contract price for Item 2 "Clearing and Grubbing" and shall include the cost of clearing and grubbing the areas specified herein and the satisfactory disposal of all materials resulting therefrom.

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SECTION IV. EXCAVATION (Items 3 to 11 incl.)

4-01. General provisions. - a. Scope of work. - The location and character of the proposed structures, and the location and logs of borings and test pits are shown on the drawings (see Paragraph 1-04.) It is the intent of the Government that excavations be made to the lines and grades shown on the drawings but the right is reserved to modify any part of the work if, in the opinion of the contracting officer, conditions require such modification (see Articles 3 and 4 of the contract).

b. Disposal of materials. - All excavated material shall be satisfactorily disposed of as directed by the contracting officer. With the exception of materials from stripping operations, all excavated materials shall, if possible, be used in the permanent work. No material, except stripping, shall be wasted unless specifically authorized by the contracting officer. If, at the time of excavation, it is not possible to place the material in the permanent work, it shall be stock-piled in approved areas for later use. Materials from the excavations that are unacceptable for use in the permanent work shall be wasted in spoil areas located upstream from the required embankments as shown on the drawings or approved by the contracting officer. After completion of all excavation, the spoil areas shall be neatly dressed, smoothly graded, sloped for drainage, and left in a sightly condition, all as directed by the contracting officer.

c. Measurement. - (1) Pay quantities for Items 3 to 10, inclusive, will be determined by the contracting officer on the basis of the volumes of excavated materials in place before excavation. The quantity to be paid for under each of contract Items 3 to 10, inclusive, will be the number of cubic yards of material excavated to the lines and grades shown on the drawings prescribed in the specifications, or ordered by the contracting officer in accordance therewith, and disposed of as required.

(2) Pay quantities for Items 3, 7, 8, 9, and 10 will be measured from the surface of the ground or rock as determined by surveys of the areas to be excavated made just prior to the commencement of the work and the bottom surface shown by a survey made as soon as possible after the completion of the excavation.

(3) Pay quantities for Items 4, 5, and 6 will be measured from the surface of the ground as determined by surveys of the areas to be excavated made just prior to the commencement of the work and the slope or pay lines indicated on the drawings or such modifications thereof as may be found necessary by the contracting officer.

d. Payment. - (1) Payment for excavation will be made at the applicable contract unit prices for Items 3 to 11, inclusive, (see Paragraph 1-05), and shall include the cost of all labor, plant, and incidentals for excavating, loading, hauling, and disposing of the mate-

rials as required, and shall include any stock-piling and rehandling that may be necessary except as provided in Paragraph 4-04 b.

(2) Pay lines, excavation for structures. - Where pay or slope lines are shown on the drawings, payment for excavation for structures will be made to said lines regardless of whether or not it is necessary to remove the material to slopes greater or less than those shown. No payment will be made for excavation beyond the limits of such lines, and the contractor will be required to backfill any such excess excavation with approved material, or with concrete where excavated surfaces are in contact with concrete structures, at his own expense.

e. Shoring. - The contractor shall be responsible for the unfinished work, and that workmen shall be safe from danger of caving and slides. Shoring may be used at the option of the contractor. If shoring is necessary and the contractor does not use it, its use will be ordered by the contracting officer. Shoring shall be erected in a safe and workmanlike manner, and shall be placed in such a way as to afford ready inspection of, and ample clearance for, the permanent work. Shoring shall be removed upon completion of the permanent work as soon as the construction does not require its use. Where shoring is used in lieu of excavation to full dimensions of the payment lines, an estimate for excavation will be made as though the excavation had been made to the payment lines shown on the drawings. No payment will be made for shoring as such, but all costs thereof shall be included in the cost of excavation.

f. Sheeting and pumping. - (1) The contractor shall provide all labor and materials wherever necessary to enclose the proposed work by temporary cofferdams or otherwise. Subject to the approval of the contracting officer, sheeting shall be so constructed and carried to such depth as to prevent excessive inflow of water and intrusion of sand and other materials into the area being excavated.

(2) The contractor shall provide all necessary pumps to unwater the site and to keep the site free of water during such time as the work is under construction. The contractor shall provide all labor and materials required to keep the site unwatered during the course of construction.

g. Temporary drains. - The contractor shall maintain the site of the work and adjacent grounds in a well-drained condition. Temporary drains and ditches required shall be constructed by the contractor at his own expense.

4-02. Classification. - a. General. - Except as otherwise prescribed all materials excavated will be classified as common excavation or rock excavation, defined as follows:

Common excavation shall include all earth, clay,

sand, gravel, and topsoil as defined below, also such hard and compact materials as hardpan, cemented gravel, shale, and soft or disintegrated rock that can be removed by hand, power shovels, or draglines without continuous and systematic blasting, and also boulders and detached pieces of solid rock less than one cubic yard in volume.

Rock excavation shall include all solid rock that cannot be excavated by hand-power shovels, or draglines without continuous and systematic blasting, and also boulders or rock fragments one cubic yard or greater in volume.

b. Detailed classification is as follows:

(1) Common stripping (Item 3) (see Paragraph 4-03).

(2) Common excavation (see Paragraphs 4-04 to 4-08, incl.).

General (Item 4)
Access road (Items 5A and 5B)
Cut-off trench (Item 6)
Borrow area "A" (Item 7)
Borrow area for access road (Item 8)
Stock pile (Item 9)

(3) Rock excavation (see Paragraph 4-09).

Rock excavation (Item 10)

(4) Line drilling and broaching (Item 11) (see Paragraph 4-10).

c. The words "soil" or "topsoil" shall mean the material composing the surface layers of the ground containing varying amounts of organic matter.

4-03. Common stripping (Item 3). - a. Work included. - The contractor shall strip the area to be covered by the dam embankment, together with strips 10 feet wide beyond and contiguous to the toe line on either side, to a sufficient depth to remove all materials not suitable for the foundation of the embankment as determined by the contracting officer. The unsuitable materials to be removed shall include topsoil, rubbish below the ground surface not removed by clearing and grubbing, all loose rock and any other objectionable material. The maximum depth of excavation classified as stripping shall be 3 feet. Any additional excavation required to remove unsuitable material shall be classified as "common excavation - general", or "rock excavation - general" as applicable.

b. Disposal of materials. - The provisions of Paragraph 4-01 b shall apply.

c. Measurement and payment. - Measurement will be made in accordance with the provisions of Paragraph 4-01 c and payment in accordance with the provisions of Paragraph 4-01 d.

4-04. Common excavation - general (Item 4). - a. Work included. - The contractor shall excavate and dispose of the materials classified as common excavation, above and below the mean water level in the river, required for the intake channel, gate structure, outlet channel, spillway weirs, drainage ditches shown on the drawings and any other required common excavation not specifically included in the other contract items.

b. Description. - Excavation for the inlet and outlet channels, and the gate structure, shall be carried on in such a manner, and at such locations, as directed by the contracting officer in order to obtain the several classes of materials required in the dam embankment during the first season of embankment construction. Where possible, materials from these excavations shall be removed in such a manner that they can be used directly in the permanent work. Materials in excess of those required for the first-season embankment construction shall be stock-piled as directed, for later use in the embankment. Re-excavation from such ordered stock-piles will be paid for under Item 9 (see Paragraph 5-03 b). No other payment will be made for any stock-piling and re-excavation from stock-piles that may be found necessary by the contractor.

c. Shoring. - The provisions of Paragraph 4-01 c shall apply.

d. Disposal of materials. - The provisions of Paragraph 4-01 b shall apply.

e. Measurement and payment. - The provisions of Paragraphs 4-01 c and 4-01 d shall apply.

4-05. Common excavation - access road (Items 5A and 5B). - a. Work included. - Under Item 5A the contractor shall excavate and dispose of all materials encountered, except rock, to the required lines and grades for the subgrade of the access road, and for backfilling, grading, or subgrade trimming of the side-slope cuts and fills. Under Item 5B he shall do any other common excavation required for bridge retaining walls, culverts, and other road structures.

b. Subgrade. - The subgrade shall be maintained in a well-drained condition during the construction. All muck, quicksand, soft clay, or other material unsatisfactory for the subgrade shall be removed to such depth as the contracting officer may direct. If rock is encountered, the rock excavation shall extend to at least one foot below the subgrade but not exceeding two feet, except for ditches, culverts, structure foundations, and steps excavated on steep slopes to secure stability for fills (see Paragraph 6-03 c).

c. Grading. - The road shall be graded in accordance with

the cross sections and profile indicated on the drawings or as directed by the contracting officer. All shoulders, ditches, and side slopes, whether excavation or fill, shall be trimmed and dressed in a neat and workmanlike manner to the lines and grades indicated on the drawings or as staked in the field. The sub-base upon which the gravel will be placed, shall be shaped to a uniformly even and regular grade in accordance with the lines and grades indicated on the drawings or as staked in the field, and compacted to the satisfaction of the contracting officer.

d. Disposal of materials. - All suitable materials excavated under Items 5A and 5B shall be placed, in an approved manner, at locations designated in the ordered road fills. Excavated materials not used in road-fill construction shall be disposed of in designated spoil areas.

e. Measurement and payment. - (1) The quantities to be paid for under contract Items 5A and 5B will be the number of cubic yards excavated and satisfactorily disposed of in accordance with the drawings or as directed. Quantities will be measured in place. (See Paragraph 4-01 c.) The contract unit prices shall include payment for the disposal of all unsuitable excavated materials (see Paragraph 4-01 d). No separate payment will be made for grading for the access road.

(2) Payment for rock excavation and line drilling and broaching will be made at the contract unit prices for Items 10 and 11 as applicable. (See Paragraph 1-05.)

4-06. Common excavation - cut-off trench (Item 6). - a. Work included. - The contractor shall excavate and dispose of the materials in the cut-off trench under the dam embankment both above and below the mean water level in the river to the lines and grades shown on the drawings, or otherwise ordered by the contracting officer. The required depth of the cut-off trench at all points cannot be known with certainty until the area is fully developed by the construction operations, but it shall extend through the overlying pervious and tie into impervious material or work. The ordered lines and grades shall include any necessary adjustment to field conditions.

b. Pumping and draining. - The contractor shall do all pumping and draining necessary to perform the excavation in the dry, and to keep the cut-off trench unwatered until it has been satisfactorily backfilled with suitable embankment material. (See Paragraph 4-01 f.)

c. Disposal of materials. - The provisions of Paragraph 4-01 b shall apply.

d. Measurement and payment. - The provisions of Paragraphs 4-01 c and 4-01 d shall apply.

4-07. Common excavation - borrow area (Items 7 and 8). - a. Work included. - The contractor shall excavate to the ordered lines and grades in any approved borrow area, and transport the additional material required for the dam embankment or other miscellaneous fills, which is not included in other excavation items. Borrow area excavation shall

include the clearing of the areas. Stripping and disposal of objectionable topsoil containing roots or other debris, and the removal and the disposal of any other objectionable material as designated by the contracting officer will be measured and paid for as borrow area excavation. To provide suitable embankment materials excavations shall be made to the depths and in the locations as directed by the contracting officer. During and after excavation the borrow areas shall be so graded that all surface water will readily drain from them. The borrow areas shall be left in a neat condition satisfactory to the contracting officer.

b. Description. - (1) Contract Item 7 shall include the excavation from borrow area "A" shown on the drawings, and contract Item 8 shall include the borrow excavation required from borrow area "G" to obtain material for the access road that is not available from the required excavations. Excavations shall be made to the depths and in the locations approved by the contracting officer so as to provide the necessary embankment or fill materials in the proper sequence for construction purposes. If the contractor desires to use areas from which the contracting officer has not previously secured and tested samples, he shall dig test pits and furnish samples to the contracting officer in sufficient time in advance of use to permit determination of suitability.

(2) The contractor shall inform the contracting officer of the locations in the borrow areas in which he intends to work a sufficient time in advance so that the contracting officer can make additional investigations of the materials without delay to the contractor. The contractor shall furnish all labor and construction equipment that is necessary to prepare for taking the samples and shall furnish labor to assist the contracting officer to take the samples.

c. Shoring. - The provisions of Paragraph 4-01 e shall apply.

d. Disposal of materials. - The provisions of Paragraph 4-01 b shall apply.

e. Measurement and payment. - The provisions of Paragraphs 4-01 c and 4-01 d shall apply. The contract unit prices for Items 7 and 8 shall include the costs of all necessary clearing, stripping, and shoring.

4-08. Common excavation - stock-pile (Item 9). - a. Work included. - The contractor shall excavate the materials from the stock-piles that have been built up during the first season of work as provided in Paragraph 4-04 b, and dispose of said materials in the permanent work or otherwise as directed by the contracting officer. Item 9 shall include the excavation and disposal of material from only those stock-piles that have been ordered to be built up in accordance with the provisions of Paragraph 4-04 b and shall not include the re-excavation of any other stock-piled material.

b. Disposal of materials. - The provisions of Paragraph 4-01 b shall apply.

c. Measurement and payment. - The provisions of Paragraphs 4-01 c and 4-01 d shall apply.

4-09. Rock excavation (Item 10). - a. Work included. - The contractor shall excavate and dispose of all rock encountered within the lines and grades of the required excavations both above and below the mean water level in the river. Item 10 shall include all rock excavation for the inlet channel, outlet channel, gate structure, and other required rock excavation not included in "Line Drilling and Broaching", Item 11.

b. Blasting. - (1) Blasting and the use of explosives shall be conducted as provided for in Paragraph 1-28.

(2) Blasting will be permitted only when proper precautions are taken for the protection of all persons, the work and the property. All damage done to the work or the property shall be repaired by the contractor at his own expense. All operations of the contractor in connection with the transportation, storage, and use of explosives shall be as approved by the contracting officer. The contractor shall be liable for all injuries or deaths of persons or damage to property caused by the blasting operations.

(3) All necessary precautions shall be taken to preserve the rock outside the lines of excavation in the soundest possible condition. Explosives of such quality and power shall be used in the locations which will, in the opinion of the contracting officer, neither crack nor damage the rock outside the lines of excavation. Blasting shall be done only to the lines and grades shown on the drawings or approved by the contracting officer. All rock removed beyond the lines and grades shown on the drawings or approved by the contracting officer shall be replaced at the expense of the contractor by suitable material, as directed by the contracting officer.

(4) Heavy blasting shall not be done against rock which will form the final foundation. The foundation shall be prepared by drilling, picking, barring, wedging, or similar methods which will leave the rock of the foundation in a solid and unshattered condition. Where required by the contracting officer, the rock shall be cut into rough steps or benches, to provide better bond and bearing surfaces. To aid inspection and to insure good bond with the concrete, the foundation shall be thoroughly cleaned by streams of water or jets of air, or a combination of both, or by wet sand-blasting, as required by the contracting officer.

(5) Approval by the contracting officer of the method of blasting or the strength and amount of the explosive used, will not relieve the contractor of his responsibility in the blasting operations.

(6) The faces of rock excavation shall be sealed where necessary so that no rock projects beyond the minimum excavation lines shown on the drawings.

c. Disposal of materials. - The provisions of Paragraph 4-01 b shall apply to Item 10. Some stock-piling may be necessary.

d. Measurement and payment. - (1) The quantities to be paid for under Item 10 will be the number of cubic yards of rock excavated and satisfactorily disposed of in accordance with the specifications and drawings or as ordered by the contracting officer in accordance therewith. Quantities will be measured in place as before excavation. (See Paragraph 4-01 c).

(2) Pay quantities for rock excavation will be measured to the actual limits of the excavation; provided that the excavation is not made beyond the minimum excavation line plus a reasonable tolerance not to exceed two feet to be determined by the contracting officer from field conditions; and provided further that where line drilling and broaching is required quantities will be measured to neat lines of structures only. Where the excavation has been made beyond the tolerance or neat lines so determined measurement for payment will be made only to the said lines.

(3) Payment will be made at the contract unit prices for Item 10, "Rock Excavation".

4-10. Line drilling and broaching (Item 11). - a. Work included. - The contractor shall line-drill and broach the vertical faces of rock excavation for the spillway weirs, and for the gate structure and sloping faces of the intake and outlet channels at the locations indicated on the drawings, or as otherwise directed by the contracting officer. The right is reserved to omit all or any part of the line drilling and broaching under Item 11, as determined by the contracting officer from field conditions.

b. Description. - The spacing of holes and method of drilling shall be determined by the field conditions as the work progresses, and as approved by the contracting officer. Blasting operations shall be performed so as not to fracture the rock beyond the line of drill holes. The rock face shall be sealed to a tolerance not exceeding 3 inches each way from the line of drill holes, except that in no case shall the rock project beyond the minimum excavation lines shown on the drawings.

c. Measurement and payment. - The quantity to be paid for under Item 11 will be the number of square feet of rock surface satisfactorily prepared at the locations shown on the drawings or in accordance with orders. Payment will be made at the contract unit price for Item 11, "Line Drilling and Broaching", and shall include payment for all materials, labor, plant, tools and all expenses necessary to do the work included in Paragraph 4-10 a.

SECTION V. ROLLED EMBANKMENT (Items 12 to 14 incl.)

5-01. Definitions. - The term "rolled embankment" as used in these specifications includes earth fill of all types for the dam and cut-off trench, and all other specified or directed earth fills within the limits of the dam necessary to complete the rolled embankment. The various types of earth fill are "selected impervious" under Item 12, for the cut-off trench and core of the embankment; "random" under Item 14A, adjacent to the core of the embankment on both upstream and downstream sides of the core; "pervious" under Item 14B, forming the upstream and downstream sections of the embankment; and "impervious blanket" under Item 13, under and beyond the upstream portion of the embankment as shown on the drawings.

5-02. Work included. - a. The contractor shall place, grade and consolidate materials required for the rolled embankment, to the elevation, lines, grades and cross sections shown on the drawings with such increased height and width as may be deemed necessary by the contracting officer to allow for later shrinkage or settlement. The contractor shall use suitable materials as selected by the contracting officer from the required excavations and borrow areas shown on the drawings.

b. The contractor shall furnish and install settlement gages of the dimensions shown and at the locations shown on the drawings.

5-03. Materials. - a. General. - All materials from required excavations will be used, if, as excavation proceeds, they are found suitable by the contracting officer for use in the embankment. Brush, roots, sod, any type of organic materials, and other perishable or unsuitable material as determined by the contracting officer shall not be placed in the embankment. Materials shall not be wasted except by specific instructions from the contracting officer.

b. Stock-piles. - When, in the opinion of the contracting officer, it is necessary during the first season of embankment construction to excavate from the required excavations material that is suitable for use in the embankment and which cannot be placed until the second season of embankment construction, such materials shall be stock-piled as directed and re-excavated during the second season as required. Payment for such re-excavation from stock-piles and hauling to the embankment will be made at the contract unit price for Item 9 (see Paragraph 4-08). Payment for re-excavation and haul from any other stock-piles found desirable by the contractor but not required by the contracting officer as herein provided shall be included in the payment for the original excavation of the material as provided in Section IV.

c. Borrow. - Other suitable materials shall be borrowed from locations shown on the drawings in accordance with Paragraph 4-07. The origin of any material from either structure or borrow excavations

does not definitely determine where it will be used in the embankment. Materials from two or more excavation or borrow areas may be required to be used at the same time and in the same part of the embankment, mixing being done in the process of placing by systematic dumping, spreading and bulldozing. Materials from one area may be required to be used in different parts of the embankment.

d. Test requirements. - The various types of earth fill defined in Paragraph 5-01 shall conform to the test requirements and approved classification established by the Soils Laboratory, U. S. Engineer Office, Providence, Rhode Island. The contractor shall furnish the necessary labor and facilities for taking test samples which will be removed from the embankment by representatives of the contracting officer and subjected to field tests or boxed for shipment to the Soils Laboratory. Test samples will be taken at such intervals as will give, in the opinion of the contracting officer, a comprehensive knowledge of the material and its placement and compaction in each section of the embankment.

5-04. Plowing. - Immediately prior to the placing of materials in the embankment, and after stripping has been completed (see Paragraph 4-03), the entire foundation of the embankment, except on exposed rock, shall be thoroughly plowed and broken to a depth of 4 inches. The furrows shall run approximately parallel to the axis of the dam embankment. All roots, stones, and debris or other objectionable material shall be removed and burned or spoiled, as directed by the contracting officer. The condition of the surface material of the foundation area at the time of plowing shall be slightly drier than the required moisture content for rolled embankment. The requirements for plowing do not apply to the side slopes of the cut-off and toe trenches, and stump holes. After plowing, the entire surface of the foundation area shall be rolled in accordance with Paragraph 5-06 d.

5-05. Filling of excavations in embankment area. - a. General. - The cut-off trench, test pits, stump holes and other excavated areas within the limits of the embankment and as otherwise shown on the drawings shall be filled with pervious, random or impervious materials as directed by the contracting officer. The material for the fills shall be secured from approved borrow areas or required excavations. The fill shall be placed in layers, moistened, and rolled in accordance with Paragraph 5-06, whenever, in the opinion of the contracting officer, it is possible to do so. Material which cannot be compacted by roller equipment on account of clearances, shall be spread in 4-inch layers and compacted with power tampers which shall give the degree of compaction required for the embankment. As the fill is brought up, the side slopes of the cut or hole shall be scarified by equipment or by hand if it is required, in the opinion of the contracting officer, in order to provide a bond between the fill and the original ground material.

b. Stump holes. - The sides of stump holes shall be broken

down with bulldozers or a disc harrow so as to flatten out the slopes, and the holes then filled with approved material and properly rolled or tamped in place.

c. Cut-off trench. - The fill for the cut-off trench shall be placed in the dry and rolled in accordance with Paragraph 5-06. The water shall be drained to a sump and removed, working the materials toward the sump and sloping the surface of the fill longitudinally toward the sump. Well points or other suitable means may be used for drying up the foundation at the contractor's option.

5-06. Rolled fill. - a. General. - (1) As soon as the cut-off trench has been filled, the impervious, random, and pervious sections of the embankment shall be brought up to a crown running with the center line of the dam with slopes approximately on a 2 percent grade toward the edges of the embankment. This slope shall be maintained until the completion of the embankment, thus constructing the impervious, random, and pervious sections in the same plane. As soon as practicable, in the opinion of the contracting officer, the embankment will be brought to a nearly uniform grade for the entire length.

(2) A portion of the embankment, as indicated on the drawings, will be required to be built during the first construction season, and in general includes that portion of the embankment that can safely be built prior to diversion of the river. Unless otherwise directed by the contracting officer, the end slope of the embankment shall be 1 vertical to 3 horizontal.

b. Furnishing and placing. - (1) The contractor may use power shovels, drag lines, or any type of excavating machinery which is capable of excavating the materials in a dry condition. The contracting officer will specify the location in the borrow areas and the depth to which excavation shall be made. The contractor may use any approved method of transporting materials in dry natural condition. The dumping of the successive loads from the borrow areas, stock-piles, or required excavations on the embankment, shall be at locations as directed or approved by the contracting officer. Sufficient excavating and hauling equipment shall be available so that not less than two sources of material can be worked at the same time. When two or more different materials are being moved into a section of the embankment they shall be spotted and dumped systematically so that in any area of the section there are approximately the required proportions of the materials. After dumping, the materials for the impervious and random sections shall be bulldozed or otherwise spread in layers approximately 6 inches in thickness after rolling (see Paragraph 5-06 d). The pervious material shall be spread in layers 8 to 12 inches in thickness after rolling as determined by the contracting officer and rolled (see Paragraph 5-06 d). Should the material for the various sections of the embankment be too high in water content when dumped, it shall be bulldozed or otherwise spread in 6-inch layers and left for a sufficient time to allow the surplus water to dry out before being rolled. If,

in the opinion of the contracting officer, the rolled surface of any layer of the random and impervious materials is too smooth to bond properly with the succeeding layer or, if the materials have dried out sufficiently to cause cracks in the surface, it shall be roughened or loosened by a disc harrow, or other approved means, to the satisfaction of the contracting officer, and dampened, if required, before the succeeding layer is placed thereon. All roots, trash, and debris shall be promptly removed from the embankment and disposed of to the satisfaction of the contracting officer. Stones greater than 6 inches in diameter shall be removed from the impervious and random sections and when approved by the contracting officer, shall be placed in the rock sections of the embankment. The entire surface of the embankment shall at all times be maintained in such condition that construction equipment can travel thereon. Routing of construction equipment on the embankment shall at all times be subject to direction by the contracting officer.

(2) Any embankment material lost or loosened, after being placed in the embankment and before the completion of the contract and acceptance of the completed work, because of floods or other actions of the river, because of any operation of the contractor or for any causes that in the opinion of the contracting officer were avoidable or under the control of the contractor, shall be replaced by the contractor to the satisfaction of the contracting officer and without cost to the Government. (See Paragraph 2-05 c.)

(3) The contractor shall cease work on the embankment at any time when, in the opinion of the contracting officer, satisfactory work cannot be done on account of rain, high water, cold weather, or other unsatisfactory conditions.

c. Moisture control. - In order to obtain the desired degree of compaction, the materials when rolled shall have the optimum moisture content practicable for the type and gradation of materials available, and it shall be uniformly distributed throughout the layer. If required, the compacted surface shall be sprinkled as directed immediately before placing each new layer. The moisture content shall be sufficient to dampen the filled materials as required, but the amount of sprinkling shall be controlled so that no free water will appear on the surface during or subsequent to the rolling. An adequate supply of water shall be available at all times, and jets shall not be directed at the embankment material with such force that the finer materials are washed out.

d. Compaction. - (1) Tamper-type roller. - Rolling for the embankment fill shall be done by a tamper-type twin roller such as a "sheeps-foot" roller, water or sand ballasted, having tamping feet uniformly staggered over its cylindrical surface, and equipped with cleaners; or other satisfactory type of tamper roller as approved by the contracting officer. Each tamping foot shall project approximately 7 inches from the roller's cylindrical surface and shall have a face area of not less than 5 and not more than 7 square inches. The spacing shall be such as to provide a minimum of two tamping feet for each square foot

of cylindrical surface. Addition or reduction in the number of tamping feet shall be made when directed by the contracting officer. The total weight of the roller in pounds divided by the total area of the maximum number of tamping feet in one row parallel to the axis of the roller shall be not less than 115 pounds per square inch tamping-foot area with the drum empty, and not less than 200 pounds per square inch tamping-foot area with the drum ballasted. The design and operation of the tamping roller shall be subject to the approval of the contracting officer.

(2) Rolling impervious section. - When the moisture content and condition of the spread layers are satisfactory to the contracting officer, the contractor shall roll the impervious sections of the embankment with tamper-type twin rollers. Each set of twin rollers shall be pulled by a crawler-type tractor of suitable power, weighing not less than 20,000 pounds, manufacturer's standard weight, at a speed of approximately 2-1/2 miles per hour. Each square foot of each layer of the embankment material shall be compacted by not less than six passes of the rollers. Additional passes of the rollers shall be made if necessary to obtain the compaction desired by the contracting officer. Successive trips of rollers shall overlap by at least 2 feet. Failure to comply with this requirement for careful rolling will be a cause for additional trips at the contractor's expense. Where new material abuts old material, either in place or in embankment, the old material shall be cut or broken by machine or hand methods approved by the contracting officer, until it shows the characteristic colors of undried materials, and the rollers shall work on both materials, bonding them together. Portions of the earth fill which the roller cannot reach for any reason shall be thoroughly compacted in 4-inch layers by tamping with power tampers. The degree of compaction for such portions of the earth fill shall be equivalent to that obtained by sprinkling and rolling as specified for the other portions of the earth fill.

(3) Rolling pervious and random sections. - Rolling of the pervious and random sections of the embankment shall be the same as specified above except that a minimum of 3 passes of the rollers will be required. If, in the opinion of the contracting officer, proper compaction can be obtained by the use of a plain cylindrical roller, or a Parson's disc tamping roller, the use of such a roller may be required. The roller shal weigh not less than 1,100 pounds per linear foot. When conditions of the work so require, as determined by the contracting officer, rolling may be done by a crawler type tractor weighing not less than 20,000 pounds; in such cases a maximum of four passes of the tractor treads on each square foot of embankment area will be required.

(4) Tests for compaction. - Samples of all embankment materials for testing, both before and after placing and compaction, will be taken by the contracting officer at frequent intervals and from these tests, corrections, adjustments and modifications of methods, materials, and moisture content will be made in order to secure the

maximum practicable density of the materials in the dam embankment (see Paragraph 5-03 d).

e. Selected impervious fill (Item 12). - Selected impervious fill shall be selected and secured from required excavations and borrow areas as directed by the contracting officer, and shall be placed in the core and blanket extending to the upstream toe throughout the entire length.

f. Random fill (Item 14A). - Random fill shall be selected and secured from required excavations and borrow areas as directed by the contracting officer, and shall be placed in the random sections of the embankment. In general this material shall be placed so the coarser portions are toward the outside edge, and the finer portions near the impervious section, so that a gradational transition is effected from the impervious to the pervious section.

g. Pervious fill (Item 14B). - The pervious fill shall be selected and secured from required excavations and borrow areas as directed by the contracting officer, and shall be placed in the pervious sections of the embankment. The pervious sections of the embankment shall be graded from the finer materials near the random sections to the coarser materials near the outer faces of the embankment. Special care shall be taken to place the coarser material and cobbles adjacent to the outer faces of the embankment.

h. Impervious blanket fill (Item 13). - (1) The impervious blanket fill shall be selected and secured from required excavations and borrow areas as directed by the contracting officer, and shall extend upstream from the impervious section of the embankment to the lines and grades shown on the drawings or as directed. In general, the materials used for the impervious blanket fill shall be similar to those for the selected impervious fill except that cobbles and rock fragments up to 2 feet in diameter will be permitted.

(2) The impervious blanket shall be spread in layers approximately 2 feet thick. No special rolling will be required for the blanket but compaction shall be obtained by routing the hauling equipment over the blanket area. The materials shall be so placed as to avoid nests or clusters of boulders.

5-07. Removal of objectionable material. - The contractor shall, when directed by the contracting officer, excavate, remove and dispose of any material from the embankment sections which the contracting officer considers objectionable in such locations, and refill the area as directed in accordance with Paragraph 5-05.

5-08. Slides. - In case of slides in any part of the embankment during the construction or after completion, but prior to the final acceptance of the work, the contractor shall cut out and remove the area specified by the contracting officer and then rebuild the excavated

area in accordance with these specifications. In case it is determined that the slide is caused through the fault of the contractor, the foregoing shall be performed at no cost to the Government.

5-09. Frozen materials. - No earth shall be placed upon a frozen surface, nor shall frozen earth, snow or ice be placed in the embankment. In cases of emergency the contracting officer may require frozen material to be stock-piled for later use in the embankment.

5-10. Shrinkage or settlement of foundation. - Additional embankment material required on account of shrinkage during construction will not be measured and paid for as fill in the embankment as such quantities are not deemed determinate. Increased quantities of materials in the embankment required by foundation settlement will be measured and paid for as fill. All determinations for foundation settlement will be based on settlement gages (see Paragraph 5-11). The amount of increased quantities due to settlement will be determined by the contracting officer after the embankment is completed and his decision shall be final. Excavation of additional materials from the borrow areas required on account of settlement and shrinkage will be paid for at the applicable contract prices.

5-11. Settlement gages. - a. In accordance with Paragraph 5-02 b, foundation settlement gages shall be furnished and installed by the contractor. The gages shall be installed in such a manner that at no time will the top of the gage pipe be closer than 18 inches below the top surface of the embankment. Upon completion of the final course over each gage, the final section of pipe shall then be brought to an elevation 12 inches above the embankment surface. Ordinarily the method of installation shall be as follows: after the embankment has been brought up to a height of 6 feet, shafts shall be excavated at the locations shown on the drawings and to such a depth as to insure that the base plates are placed on a level area of undisturbed ground at the bottom of the plowed furrows. The base plate with attached section of pipe shall be placed and the pipe capped. The backfill will then be brought up to the top of the shaft in 4-inch tamped layers in accordance with Paragraph 5-06 d (2). Gravel shall be used for backfilling the perforated portion of the pipe only. Shafts through succeeding 5-foot increments of embankment shall be excavated and sections of gage pipe attached. In all cases the shafts shall be backfilled in 4-inch tamped layers. Shaft excavation shall be used for shaft backfill unless otherwise ordered.

b. Payment for furnishing and placing the metal base plates and pipe for the gages will be made at the contract unit prices for Items 35 and 38 (see Paragraph 12-09 b). Payment for excavation will be made at the contract unit price for Item 4 (see Paragraph 4-04). Payment for placing the backfill will be made at the contract unit price for Item 17 (see Paragraph 6-04).

5-12. Temporary drains and ditches. - The contractor shall maintain

the site of the work and the grounds immediately adjacent thereto, free from collected surface water, if, in the opinion of the contracting officer such collected water affects the safety or condition of the work. Such temporary drains and ditches shall be constructed as are deemed necessary and directed by the contracting officer.

5-13. Filling unauthorized excavations. - If the contractor excavates anywhere outside the ordered limits or below the ordered grades without permission, he shall refill such excavations at his own expense with acceptable materials placed as directed by the contracting officer.

5-14. Measurement and payment. - a. The quantities to be paid for under Items 12, 13 and 14A and 14B will be the number of cubic yards placed between the foundation surfaces as corrected for settlement during construction and the slope lines and grades as shown on the drawings or as modified by the contracting officer. The contract unit prices shall include payment for preparing the base, placing materials, spreading in layers, wetting, rolling or tamping, trimming to line, and shall include the cost of all labor and materials incidental to satisfactorily completing the embankment, not specifically included for payment under other items.

b. Payment will be made to the contractor to replace embankment washed out by flooding or overtopping of cofferdams (see Paragraph 2-05 c), or required by slides, or the removal and disposal of all objectionable materials as directed by the contracting officer, provided such replacement of embankment was not caused by negligence or carelessness of the contractor, or by inadequate construction of cofferdams to the specified effective elevations (see Section II). Payment for replacement of embankment will be at the applicable contract unit prices; payment for any necessary excavation preliminary to replacement of embankment will be at the contract unit price for Item 4. The quantities to be paid for will be the number of cubic yards for the respective items of work measured as the contracting officer may direct.

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SECTION VI. MISCELLANEOUS FILL AND BACKFILL (Items 15 to 19 incl.)

6-01. Definitions. - "Gravel bedding", Item 15, includes the gravel blanket immediately underlying the various items of rock fill and riprap as shown on the drawings and the gravel required for filters. "Fill (unclassified)", Item 16, is confined to the access road. "Compacted backfill", Item 17, is generally structure backfill behind retaining walls and structures as shown on the drawings. "Semi-compacted backfill", Item 18, refers to miscellaneous backfill not completely compacted. "Gravel for roads", Item 19, includes material required for the access road and for the road across the top of the dam.

6-02. Gravel bedding (Item 15). - a. Work included. - The contractor shall place a layer of gravel or crushed stone of the specified quality as a foundation for the riprap required at the intake and outlet channel, and on the upstream and downstream slopes of the dam embankment if ordered by the contracting officer, and at other locations shown on the drawings or as directed by the contracting officer.

b. Materials. - (1) Gravel bedding shall consist of suitable coarse clean gravel from approved sources. The material shall not exceed 6 inches maximum size and shall be well graded within the following requirements:

	Total Passing (Percent by Weight)
2-inch sieve	70 - 100
#28 sieve	0 - 20

(2) It is anticipated that ample quantities of materials meeting these specifications without processing and with only a limited amount of selection necessary, can be obtained from borrow area "A", but whether obtained from borrow area "A" or from other approved sources the material shall meet the requirements of subparagraph (1) above.

(3) Crushed stone may be used in place of gravel if approved by the contracting officer. Crushed stone shall consist of angular fragments of uniform quality throughout, free from soft or disintegrated stone, dirt or other objectionable matter. The provisions of Paragraph 9-07 b shall apply. The stone shall be uniformly graded within the specified limits. Unless otherwise directed not more than 10 percent by weight shall pass a No. 4 sieve, and all shall pass a 2-inch square-mesh screen. The material shall be obtained from approved sources.

c. Placing. - The material shall be placed as shown on the drawings or as directed, and with such hand-placing as may be necessary to trim to the required slopes. The contractor will not be

required to tamp or roll the material, but will be required to consolidate it with water to the extent directed so that no settlement or voids will later result.

d. Measurement and payment. - The quantity to be paid for under Item 15 will be the number of cubic yards placed to the limits shown on the drawings, or ordered. Payment will be made at the contract unit price for Item 15, "Gravel bedding".

6-03. Fill (unclassified) - Access road (Item 16). - a. Work included. - The contractor shall place, grade, and consolidate suitable materials required for the subgrade fills of the access road, to the elevations, lines, grades, and cross sections shown on the drawings.

b. Materials. - Suitable materials shall be obtained from the required excavations as shown on the drawings. Additional suitable materials required for the subgrade fills shall be obtained from borrow area "G" shown on the drawings.

c. Placing. - Subgrade fills shall be placed in successive layers of not more than twelve inches in depth for the full width of the cross section, each layer to be rolled thoroughly with a three-wheel power roller weighing not less than ten tons. Stumps, trees, rubbish or other unsuitable materials shall not be placed in the fill. If the bottom of the fill is of insufficient width to permit the use of the roller, the material shall be compacted in a manner satisfactory to the contracting officer. If the angle of the slope of the original surface of the ground, measured at right angles to the center line of the fill, is greater than thirty degrees from the horizontal, the original surface shall be thoroughly broken up for the full width of the fill as directed by the contracting officer.

d. Grading. - The road shall be graded in accordance with the cross sections and profile indicated on the drawings or as directed by the contracting officer. All shoulders, ditches, and side slopes, whether excavation or fill, shall be trimmed and dressed in a neat and workmanlike manner, to the lines and grades indicated on the drawings or as staked in the field. The sub-base upon which the gravel base course will be placed, shall be shaped to a uniformly even and regular grade in accordance with the lines and grades indicated on the drawings or as staked in the field, and compacted to the satisfaction of the contracting officer.

e. Measurement and payment. - (1) The quantity to be paid for under Item 16 will be the number of cubic yards furnished and satisfactorily placed in accordance with the drawings or orders. Quantities will be measured in place after compacting. The contract unit price shall include payment for placing, grading, compacting, trimming the materials for access road gravel base and any work incidental thereto.

(2) To determine the quantities for which payment will be made, a survey will be conducted prior to the beginning of the placing of the fill. The true surface condition will be shown by cross sections and profile and the measurement of the quantities will be based upon this survey. The quantities will be the volume between the original surface at the beginning of the work and the slope lines and grades at the completion of the work. The slope and grade lines will be as indicated on the drawings, or as established by the contracting officer.

(3) Payment will be made at the contract unit price for Item 16, "Fill (Unclassified) - Access Road".

6-04. Compacted backfill (Item 17). - a. Work included. - The contractor shall place, grade and consolidate materials required for backfill of structures, and elsewhere as directed.

b. Materials. - Materials shall be borrowed from locations shown on the drawings in accordance with Paragraph 4-07, or may be obtained from required excavations. Selection of impervious, pervious, random or combinations of materials, shall be made as shown on the drawings or as directed by the contracting officer. Backfill material shall be free from stumps, roots, sod, rubbish or other unsuitable materials or substances.

c. Placing. - The backfilling shall be placed and compacted as specified in Paragraphs 5-06 d (2) or 5-06 d (3) as applicable, and graded and trimmed to the required lines and grades.

d. Measurement and payment. - The quantity to be paid for under Item 17 will be the number of cubic yards placed in accordance with the drawings or as directed by the contracting officer, measured in place after compacting. Payment will be made at the contract unit price for Item 17, "Compacted Backfill", and shall include payment for placing, compacting, grading and trimming the materials and any work incidental thereto.

6-05. Semi-compacted backfill (Item 18). - a. Work included. - The contractor shall place, grade and consolidate materials required for the backfill at the concrete spillways and miscellaneous backfills at other locations as shown on the drawings or as directed by the contracting officer.

b. Materials. - The provisions of Paragraph 6-04 b shall apply.

c. Placing. - The material shall be placed in 12-inch horizontal layers with only such hand placing as may be necessary to trim to the required slopes. The contractor will not be required to roll the material, but will be required to consolidate it with water to the extent directed so that no settlement or voids will later result.

d. Measurement and payment. - The quantity to be paid for under Item 18 will be the number of cubic yards placed in accordance with the drawings or as directed by the contracting officer. Quantities will be measured in place, after any settlement. Payment will be made at the contract unit price for Item 18, "Semi-Compacted Backfill", and shall include payment for placing, consolidating, grading, and trimming the materials, and any work incidental thereto.

6-06. Gravel for roads (Item 19). - a. Work included. - The contractor shall furnish and place gravel or crushed stone of the sizes and quality specified or ordered for the roadway across the top of the dam, and for the base course of the access road, as indicated on the drawings. Gravel for the access road shall not be placed until after installation of all metal culverts, and concrete (see Paragraph 10-04).

b. Material. - The gravel shall be composed of hard, durable stones, free from thin or elongated pieces, together with sand and clay or other approved binding material. It shall be of such sizes for the bottom course that all will pass a 3-inch screen with square openings and not less than 40 percent will be retained on a 1/4-inch screen with square openings; and for the top course all will pass through a 3/4-inch screen with square openings, and not less than 35 percent will be retained on a 1/4-inch screen with square openings; and for either course it shall be uniformly graded. The finer material shall consist of sand and clay or other binding material approved by the contracting officer. Should the material as received for the work fail to maintain suitable proportions of coarse and fine particles, or should the coarse particles not be uniformly graded between the maximum and minimum sizes as specified, it shall be screened or processed in such a manner as to furnish a material to meet the above requirements.

c. Placing. - (1) The material shall be placed in two layers, a base course and a top course, each 4-1/2 inches thick after compaction. After the subgrade or foundation shall have been properly prepared and compacted and proper drainage provided, the bottom course of gravel shall be spread evenly by means of approved spreader equipment or trucks. The material as spread shall be well-graded with no pockets of fine material or segregation of large and fine particles. The material, after being spread, shall be compacted until a firm even surface is obtained by rolling with a self-propelled three-wheel roller weighing not less than ten tons. After the bottom course has been properly and satisfactorily compacted the top course shall be spread and compacted to the required thickness. If at any time the material does not contain a sufficient amount of moisture to insure proper binding of the material, water shall be added by means of a sprinkling wagon, or other approved method, in a sufficient amount to obtain the desired results.

(2) Rolling shall start longitudinally at the side and gradually proceed toward the center of the roadway overlapping on successive trips. During the process of rolling, the surface shall be dragged; the dragging and rolling shall continue until the material does not creep or wave under the roller.

d. Shoulders. - Shoulders shall be constructed as indicated on the drawings. Before the final completion of the work the shoulders shall be reformed, trimmed, raked and rolled.

e. Measurement and payment. - The quantity to be paid for under Item 19 will be the number of cubic yards furnished and placed in accordance with the drawings or as directed. The material will be measured in place after compacting. Payment will be made at the contract unit price for Item 19, "Gravel for Roads", and shall include payment for all expenses incidental to furnishing, placing, rolling or otherwise compacting the gravel, and for sand and fine grading of gravel surfaces.

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SECTION VII. ROCK FILL, RIPRAP, AND DRAINS (Items 20 to 24 incl.)

7-01. Dumped rock fill (Item 20). - a. Work included. - The contractor shall furnish all equipment and labor required to construct the dumped rock fill on the slopes and in the toes of the dam embankment. The rock fill shall be to the limits shown on the drawings, or as directed by the contracting officer.

b. Material and placing. - (1) The rock fill furnished shall be composed of durable stone of acceptable sizes. Suitable rock, boulders and large cobbles from borrow areas and from the required excavations may be used. The dumped rock in the embankment shall have no broken stone or gravel small enough to pass a 2-inch ring and at least 50 percent of the volume shall consist of stones exceeding 1/2 cubic foot in volume. The maximum allowable size of single pieces of rock shall be one cubic yard. The rock fill shall be constructed as shown on the drawings or as directed. Dumped rock fill shall not be placed by hand, except to rearrange surface stones to bring the surface to the required lines and grades. The rock shall be placed with the larger rocks at the outer faces of the slope. The rock slopes shall be brought up in not more than 5-foot lifts, as the construction of the dam embankment progresses and shall not lag more than 15 feet, slope measurement, behind the rolled fill, except on the cofferdam. The boulders and large cobbles used shall contain a sufficient number of large angular stones to give stability to the entire mass.

(2) The rock forming the finished slopes of the embankment shall present a reasonably smooth even surface with a variation not exceeding 6 inches above or below the slope line shown on the drawings. Rock contrasting in color or shape, which appears at the finished surface of the embankment slopes, shall be uniformly distributed as far as practicable.

c. Measurement and payment. - The quantity to be paid for under Item 20 will be the number of cubic yards of dumped rock fill satisfactorily placed to the specified lines or grades in the completed work. Payment will be made at the contract unit price for Item 20, "Dumped Rock Fill", which shall include payment for furnishing, loading and hauling, selecting, placing and trimming the dumped rock fill.

7-02. Hand-placed riprap (Item 21). - a. Work included. - The contractor shall furnish all equipment and labor required to construct hand-placed riprap on the slopes, adjacent to the access bridge and the road on top of the dam embankment, and elsewhere as shown on the drawings or as directed by the contracting officer.

b. Material and placing. - (1) Hand-placed riprap shall be composed of durable rock of acceptable sizes. Suitable rock from borrow areas, and from the required excavations may be used. The riprap shall be laid to the lines and grades shown on the drawings or as directed.

A tolerance of 2 inches above or below the slope line shown on the drawings will be allowed from the finished slope surface of the hand-placed riprap.

(2) Rock for hand-placed riprap shall be angular and of uniform shape so as to furnish an even, reasonably smooth surface. No individual rock shall be smaller than one-half cubic foot in volume and at least 75 percent of the rock used shall be one cubic foot in size with one dimension approximately equal to the depth of the course. The rock shall be hand-placed on a base of gravel bedding (see Paragraph 6-02 a), closely laid with the dimension approximately equal to the depth of the course normal to the slope, and with joints broken where possible. The joints on the surface of the riprap shall be filled with tightly driven spalls. Large rock shall be well bedded at the edges of the riprap to prevent undermining.

c. Measurement and payment. - The quantity to be paid for under Item 21 will be the number of cubic yards of riprap satisfactorily placed to the specified lines and grades in the completed work. Payment will be made at the contract unit price for Item 21, "Hand-placed Riprap", and shall include payment for furnishing, loading and hauling, selecting, placing, and trimming the riprap.

7-03. Grouted stone gutters (Item 22). - a. Work included. - (1) The contractor shall furnish all equipment and labor required to construct hand-placed riprap for paving the drainage ditches at the locations and to the dimensions, lines and grades shown on the drawings.

(2) The contractor shall furnish and place grout for surface grouting all hand-placed riprap in the drainage ditches.

b. Material and placing. - (1) Riprap shall be composed of durable stone of acceptable sizes. Suitable rock from borrow areas and from the required excavations may be used. The riprap shall be laid to the lines and grades shown on the drawings or as directed.

(2) Rock for riprap shall be fragments of stone, of uniform shape so as to furnish an even, reasonably smooth face with one dimension approximately equal to the depth of the course. No individual stones shall be less than 10 pounds or more than 30 pounds in weight; and at least 75 percent of the stone shall be at least 20 pounds in weight. The stone shall be hand-placed, to a tolerance of one inch above or below the finished surface shown on the drawings, closely laid, generally with the dimension approximately equal to the depth of the course normal to the slope, with joints broken where possible.

(3) Grouting shall be done on clean riprap surface with a grout mixture composed of one part Portland cement and 2-1/2 parts sand by volume, combined with water to a suitable consistency. The grout shall be worked into the joints of the riprap surface with brooms or other means so as to completely fill the voids.

c. Measurement and payment. - (1) The quantity to be paid for under Item 22 will be the number of square yards of riprap placed to the specified lines or grades in the completed work. Payment will be made at the contract unit price for Item 22, "Grouted Stone Gutters", and shall include payment for loading, furnishing, hauling from stockpile or grizzly, selecting, placing, and trimming the riprap.

(2) The contract unit price shall also include payment for all labor and materials directly or indirectly connected with furnishing and placing the specified grout.

7-04. Gravel filled drains (Item 23). - a. Work included. - The contractor shall excavate the trenches, and shall furnish and place the gravel and felt, for the gravel-filled drains indicated on the drawings, under the concrete floor of the intake or at other locations indicated on the drawings or as directed by the contracting officer.

b. Description. - (1) The trenches for the gravel drains shall be excavated to the dimensions and in the locations shown on the drawings except as otherwise directed by the contracting officer. The gravel backfilling used shall be graded so that not more than 5 percent by weight passes a 1/4-inch standard mesh screen and not more than 5 percent by weight is retained on a 2-inch standard mesh screen.

(2). The gravel-filled drains shall be protected from concrete intermixture by a layer of asphalt-saturated felt, conforming to Federal Specification HH-F-191, Type II, 36 inches wide. The felt shall extend beyond the trench a minimum of 9 inches on each side. Black steel relief pipes, 2-1/2 inches inside diameter, shall extend from the gravel drain through the protective felt and concrete floor slab or side walls and brought flush to the finished concrete surfaces as indicated on the drawings.

c. Measurement and payment. - The quantity measured for payment under Item 23 will be the number of linear feet of gravel-filled drains actually constructed where required. The contract unit price for Item 23 shall include payment for excavating the trenches and for furnishing all material and labor incidental to the construction of the gravel drains required, except the relief pipes which are included in Item 38. Payment will be made at the contract unit price for Item 23, "Gravel-Filled Drains".

7-05. 12-Inch corrugated metal pipe (Item 24). - a. Work included. - The contractor shall furnish and lay corrugated metal pipe required for culverts, as shown on the drawings or as directed.

b. Materials. - (1) All pipe shall be of 12-gage metal and shall meet the requirements of Federal Specification QQ-C-806, as amended March 1936, and in addition shall be completely coated inside and out with an asphalt cement, which will meet the performance requirements set forth herein.

(2) The asphalt cement shall be 99.5 percent soluble in carbon bisulphide.

(3) Thickness of coating. - The entire outside of the pipe and the inside of the pipe for three-fourths of the circumference (top of pipe when installed) shall be uniformly coated to a minimum thickness of .05 inches. The thickness shall be measured on the crests of the corrugations. The interior bottom quarter of the circumference shall be of such thickness as to comply with the Erosion Test herein described.

(4) Stability test. - The asphalt cement shall not lose its stability when subjected to the highest summer temperature, as indicated by successfully withstanding the following test:

Parallel lines shall be drawn along the valleys of the corrugations of a representative sample of coated pipe and the specimen placed on end in a constant temperature oven, with the parallel lines in a horizontal position. The temperature of the specimen shall be maintained within 2 degrees F. of 150 degrees F. for a period of four hours. At the end of this time no part of any line shall have dropped more than one-fourth inch.

(5) Impact test. - The coating shall adhere to the metal tenaciously and shall not chip off in handling, as indicated by successfully withstanding the following test:

A steel ball 2-1/4 inches in diameter and weighing 1.67 pounds shall be dropped from a height of 7-1/2 feet through a vertical tube of 2-1/2 inch inside diameter, upon the outside crest of a coated corrugation of a full round, riveted section of culvert pipe. This test shall be conducted with the specimen at a temperature of 32 degrees F. Failure of the coating on the inside of the culvert pipe, as indicated by spalling from the metal or the formation of cracks longer than 1/2 inch from the point of impact, shall be considered sufficient cause for rejection.

(6) Imperviousness test. - The asphalt cement shall be impervious to liquids as indicated by the following test:

A 25 percent solution of sulphuric acid, or a 25 percent solution of sodium hydroxide, or a saturated salt solution (such as sodium chloride) shall be held in the valley of corrugation for a period of 48 hours, during which time no loosening or separation of the bituminous material from the galvanizing shall have taken place.

(7) Erosion test. - A representative sample consisting of a two-foot length of a fully coated pipe (with ends closed by suitable bulkheads) shall be revolved end over end about its transverse axis at a speed of 3.7 revolutions per minute and in such a manner that the erosive charge shall alternately roll along the inner surface of opposite sides

of the pipe (inside top and bottom, as when installed in service). At least 75 percent of the sample shall be immersed, as it revolves, in a bath of water maintained at a temperature of 50 degrees - 55 degrees F. The top three-quarters of the pipe shall not show areas of bare metal more than two inches in length on four of the seven central corrugations after five hours of continuous testing (called a test period) and the bottom one-quarter shall not show a similar failure in nine additional periods of testing. A new erosive charge shall be used for each period of test. The erosive charge shall be 50 pounds of grade B building brick, conforming to the requirements of the A.S.T.M. Serial Designation C62-30, broken up into pieces two to three inches in diameter, and three gallons of water.

c. Inspection. - (1) Mill or shop inspection. - The contractor shall notify the contracting officer at least three calendar days in advance as to the date on which, and the place at which, the fabrication will begin. He shall provide free access at all times for the contracting officer or his authorized representative to all parts of the mill or shop where the material is being fabricated and bituminous treated, and shall provide the necessary facilities and assistance for making thorough examinations. No material shall be shipped from the mill or shop until the contractor is notified by the contracting officer that the results of inspections and prescribed tests are satisfactory. Because standard testing equipment used to test this material in accordance with these specifications requires that the specimens or samples be of 15-inch diameter, it is understood that the contracting officer or his agent shall be furnished, without charge to the Government, necessary samples which shall be bituminous treated at the same time and under identical conditions as the material for delivery under this contract.

(2) Field inspection. - It is expressly understood that the successful passing of the test specimens in the laboratory will not eliminate possibility of rejection at the site in event the material as delivered does not pass visual inspection.

d. Excavation. - Excavation shall be done as shown on the drawings and as provided for in Paragraph 4-05. Pipe trenches shall have a width at least 12 inches greater than the outside diameter of the pipe. The bottom of the trench throughout its length shall be carefully formed to fit the circular shape of the pipe, so that the pipe shall be firmly supported on the bottom and for at least 3 inches up each side. All rock or boulders shall be removed to a depth of 6 inches below the bottom grade of the trench and the voids backfilled with well-compacted suitable material.

e. Laying pipe. - All pipe shall be placed in the trench immediately after the excavation is completed. Proper care shall be used in handling the pipe to avoid injury. The pipe shall be carefully bedded, and properly connected and jointed. The pipes shall be laid true to the lines and grades shown on the drawings or as staked in the

field. The interior of the pipe shall be carefully cleaned after laying to remove dirt and other obstructions.

f. Backfilling. - Backfill material shall be evenly spread and compacted under and around the pipe. Backfill over the pipe shall be done in accordance with the provisions of Paragraph 6-03, unless otherwise shown on the drawings or directed by the contracting officer.

g. Measurement and payment. - (1) Measurement for payment will be based on the linear feet of pipe installed. Payment for pipe shall include all costs of furnishing and installing the pipe except the cost of excavation, backfilling, and any concrete required. Payment will be made at the contract unit price for Item 24, "12-Inch Corrugated Metal Pipe".

(2) Payment for excavation will be made at the contract unit price for Item 5B (see Paragraph 4-05 c). Payment for concrete will be made at the contract unit price for Item 31 (see Paragraph 10-04 b).

SECTION VIII. DRILLING AND GROUTING (Items 25, 26 and 27).

8-01. Work included. - The contractor shall drill grout holes and holes for anchors and weepers, and shall grout all grout holes; all as shown on the drawings and required by the specifications. Item 25 includes the drilling of grout holes by core or rotary methods; Item 26 includes the drilling of grout holes by means of jackhammers or similar drilling equipment; and Item 27 includes the pressure grouting of all grout holes. The furnishing and installing of grout pipes and connections is included in Item 30.

8-02. Drilling grout holes. - a. Each grout hole shall be drilled through a 2-1/2-inch black steel pipe that has previously been set in the concrete. The holes shall be not less than 2 inches in diameter when completed. Grout holes will ordinarily be required to be drilled to a depth of 20 feet and in no event more than 25 feet. The locations and depths of grout holes shall be as shown on the drawings or as directed by the contracting officer.

b. Each grout hole shall be protected from becoming clogged or obstructed by being suitably capped until the hole is grouted and any hole that becomes obstructed before being grouted shall be opened by and at the expense of the contractor.

8-03. Core or rotary drilling (Item 25). - a. Grout holes and other holes that are required to be drilled by core or rotary methods shall be drilled in such a manner as to obtain satisfactory cores of the materials through which the holes are drilled. These cores shall be carefully preserved by the contractor for inspection by the contracting officer.

b. The quantity to be paid for under Item 25 will be the number of linear feet of holes drilled by core or rotary methods in accordance with the specifications and drawings and as directed by the contracting officer. Payment will be made at the contract unit price for Item 25, "Core or Rotary Drilling," and shall include the cost of drilling and capping the holes, maintaining them free of obstructions until they are grouted, and the preserving of the cores.

8-04. Ordinary drilling (Item 26). - a. All grout holes, holes for anchor bars and weepers, and other drilled holes from which cores are not required, shall be drilled by means of jackhammer or other ordinary drilling equipment. Holes for anchors and weepers shall be of the depth shown on the drawings, which will ordinarily not exceed 6 feet. The locations and depths of all holes shall be as shown on the drawings or as directed by the contracting officer. No hole shall be less than 2 inches in diameter. After being drilled, all holes shall be thoroughly cleaned by flushing out with air and water under pressure and removing all excess water. The holes shall be tightly plugged or

capped until they are grouted or otherwise completed.

b. The quantity to be paid for under Item 26 will be the number of linear feet of hole drilled by ordinary drilling methods in accordance with the specifications and drawings and as directed by the contracting officer. Payment will be made at the contract unit price for Item 26, "Ordinary Drilling" and shall include the cost of drilling, cleaning and capping the holes, and maintaining them free from all obstructions until they are grouted or otherwise completed.

8-05. Pressure grouting (Item 27). - a. Each drilled grout hole shall have forced into it, under a pressure of 50 pounds per square inch unless a lower pressure is ordered, grout composed of Portland cement and water or Portland cement, sand, and water in proportions as determined by the contracting officer. Cement shall conform to the requirements of Paragraph 9-05 for Portland cement for concrete, and sand shall conform to the requirements of Paragraph 9-06 for fine aggregate. The apparatus for mixing and placing the grout shall be a positive displacement-type pump capable of effectively mixing and stirring the grout and forcing it into the holes in a continuous, uninterrupted flow at any desired pressure up to the maximum required. The grouting equipment shall be maintained in a satisfactory condition so as to insure continuous and efficient performance during any grouting operation.

b. Before pressure grouting is begun in any group of holes, each grout hole shall be thoroughly washed out by inserting a pipe to the bottom of the hole and introducing clear, clean water under continuous pressure, and all grout holes shall be tested for leakage with clean water under continuous pressure. The amount of pressure shall be as ordered by the contracting officer, but shall not exceed the required grouting pressure.

c. Grouting operations at each hole shall be started with a thin grout mixture having a water-cement ratio not exceeding six by volume (six parts of water to one of cement). As the grouting of the holes proceeds, the water-cement ratio shall be gradually decreased until it becomes one part water to one part cement by volume. The addition of sand to the grout mortar shall be as ordered by the contracting officer. The required final grouting pressure shall be maintained until all flow has stopped. After the grouting of the hole is finished, the pressure shall be maintained by means of a stopcock or other suitable device until the grout has set sufficiently so that it will be retained in the hole. Ungrouted holes shall be left open to facilitate the escape of air and water, but if during the grouting operation the grout is found to flow from an adjacent hole or holes in amounts that will interfere with the grouting operations, the open holes shall be capped temporarily. Any hole lost through negligence of the contractor or failure of equipment shall be redrilled and grouted at the expense of the contractor.

the main reservoir sno

ould be expected irrespective of those differences.

d. The quantity to be paid for under Item 27 will be the number of cubic feet of grout mixed and placed in the grout holes in accordance with the requirements of the specifications and drawings. Measurement will be made on the basis of the number of sacks of cement and cubic feet of sand, counted separately, actually forced into the grout holes or grout connections. The volume of a sack of cement will be considered as one cubic foot and the volume of the sand will be taken as that of the sand in its loose, dry state. Payment will be made at the contract unit price for Item 27, "Pressure Grouting", and shall include the cost of all labor, materials, and equipment required for the grouting, except that cement will be paid for separately at the contract price for Item 28 and black steel grout pipes will be paid for at the contract price for Item 38.

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SECTION IX. CONCRETE (Items 28 to 33 incl.)

COMPOSITION, CLASSIFICATION AND STRENGTH

9-01. Composition. - Concrete shall be composed of cement, fine aggregate, coarse aggregate, and water, so proportioned and mixed as to produce a plastic, workable mixture in accordance with all requirements under this section and suitable to the specific conditions of placement.

9-02. Classification. - Except where required to meet special conditions all concrete shall be either Class "A" or Class "B", as designated in Section X and on the drawings for the various parts of the work in accordance with the conditions of application and the proportions of materials and strengths required.

9-03. Strength. - The mixes will be designed to secure concrete having at least the following compressive strengths at the age of 28 days, as determined by breaking standard 6-inch diameter by 12-inch height or 8-inch diameter by 16-inch height test specimens:

Class	Average for any 25 consecutive cylinders	Minimum for any one cylinder
A	3400 lbs. per sq. in	2600 lbs. per sq. in.
B	3000 lbs. per sq. in.	2200 lbs. per sq. in.

9-04. High-early-strength concrete. - High-early-strength concrete made with high-early-strength Portland cement or other special cements shall be used only when specifically authorized by the contracting officer. The 7-day compressive strength of concrete of any class, when made with high-early-strength cement, shall be at least equal to the specified minimum 28-day compressive strength for that class. All provisions of these specifications, except for cement, shall be applicable to such concrete. Any high-early-strength cement used shall be approved by the contracting officer before use.

MATERIALS.

9-05. Portland cement (Item 28). - a. The contractor shall furnish Portland cement of the quality herein specified in sufficient quantity for the work required. Cement for all concrete, grout and mortar, except as specified in Paragraph b, shall conform to Federal Specification SS-C-206, for "Cement, Portland, Moderate-Heat-of-Hardening, September 30, 1936," except that Paragraph E-7, Heat of Hydration, shall be considered inoperative.

b. High-early-strength Portland cement. - Cement for high-early-strength concrete shall be in accordance with Federal Specifica-

tions SS-C-201, for "Cement, Portland, High-Early-Strength."

c. Special test requirements. - Cement will be tested by the Government at the Central Concrete Laboratory, West Point, New York. No cement shall be used until notice has been given by the contracting officer that the test results are satisfactory. Cement which has been stored, other than in bins at the mills, for more than 4 months after being tested shall be retested before use. Ordinarily, no cement shall be used until after it has satisfactorily passed both the 7- and 28-day tests, but in cases of emergency the contracting officer may waive the 28-day tests and permit the use of cement which has satisfactorily passed the soundness and 7-day tests; provided it is the product of a quarry and mill having established a reputation of not less than 3 years' standing, for the production of high-grade cement. If the tests prove any cement unsatisfactory which has been delivered at the site of the work, such cement shall be promptly removed from the work and its vicinity.

d. Identification. - Cement shipped in bags shall be identified by the manufacturer by marking or tagging the bags with the identifying number or symbol of the Federal Specification under which it was manufactured. Bulk shipments of cement shall be likewise identified by a suitable device affixed to each car or other type of bulk carrier. Marking or tagging shall be done at the mill.

e. Quality and packages. - All cement shall be dry, finely ground and free from lumps or caking. Unless otherwise permitted, the cement shall be delivered in canvas bags or other strong, well-made packages, each plainly marked with the manufacturer's brand. The weights of such bags shall be uniform. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages. Cement shall be stored in a satisfactory manner so as to be unaffected by moisture, keeping each carload separate until the results of the 28-day tests are known. Suitable accurate scales shall be provided by the contractor for weighing the cement.

f. Records of cement used. - The contractor shall furnish to the contracting officer, at the end of each day's work, a statement showing in such detail as he may reasonably require the quantity of cement used during the day at each part of the work.

9-06. Fine aggregate. - a. Composition. - Fine aggregate shall be natural sand.

b. Quality. - Fine aggregate shall consist of hard, strong, durable and uncoated particles.

c. Grading. - (1) Except as provided in (2) below fine aggregate shall conform to the following requirements:

Total passing	-	Per cent by weight
No. 4 sieve		95 - 100
No. 16 sieve		45 - 75
No. 50 sieve		10 - 25
No. 100 sieve		1.5 to 7

(2) Deficiencies in the percentages of fine aggregate passing #50 and #100 sieves, as required in the above gradation, may be remedied by the addition of pozzuolanic or cementitious materials, excepting Portland cement; provided, at least 5 percent passes the #50 sieve and the aggregate is of proper consistent gradation within the specified limits. Such added material, which will be considered and included as fine aggregate, shall conform to the requirements in Paragraph 9-08 and shall be in sufficient quantity to meet the minimum requirements above for percentage passing #100 sieve and otherwise to produce the workability required by the contracting officer. The quantity and characteristics of any material used for the purpose of correcting workability shall be such that when the concrete is gaged to the proper consistency the total water content shall not exceed by more than 1 gallon per cubic yard the minimum quantity required for proper consistency when not using the admixture. The blending of any material with the original naturally graded sand to remedy deficiency in gradation shall be accomplished in charging the mixture, unless otherwise specifically authorized by the contracting officer.

d. Deleterious substances. - The substances designated shall not be present in excess of the following amounts:

	Per cent by weight
Clay lumps	1
Material removed by decantation from aggregates	3
Shale	0.5

e. Mortar strength. - Mortar specimens made with the fine aggregate shall have a compressive strength at 28 days of at least 90 percent of the strength of similar specimens made with Ottawa sand having a fineness modulus of 2.40± 0.10.

f. Tests. - Fine aggregate shall be subject to careful, thorough analyses, including magnesium sulphate soundness tests (see Paragraph 9-07 d), to determine conformity with all requirements of these specifications.

9-07. Coarse aggregate. - a. Composition. - Coarse aggregate shall be washed gravel, crushed stone or any approved mixture of

washed gravel and crushed stone.

b. Quality. - (1) Coarse aggregate shall consist of hard, tough, and durable particles free from adherent coating. It shall contain no vegetable matter nor soft, friable, thin or elongated particles in quantities considered deleterious by the contracting officer. The substances designated shall not be present in excess of the following amounts (by weight):

Soft fragments	5%
Clay lumps	1/4%
Removed by decantation	1%

The total quantity of deleterious substances shall not exceed 5%. When the material removed by decantation consists essentially of crusher dirt the maximum amount permitted may be raised to 1-1/2 percent. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered by the work under consideration, shall not be used. When crushed stone is used the crusher shall be equipped with a screening system which will entirely separate the dust from the stone and convey it to a separate bin.

c. Size. - (1) Coarse aggregate shall be well graded from fine to coarse so that concrete of the required workability, density, and strength can be made without the use of an excess amount of sand, water, or cement.

For Class "A" concrete, the maximum size mesh screen for the aggregate shall be one inch;

For Class "B" concrete, the maximum size mesh screen for the aggregate shall be two inches.

(2) When the maximum size mesh screen is greater than one inch, the aggregate shall be separated, and the specified sizes delivered separately to individual proportioning hoppers, in accordance with the following:

For Maximum Size Mesh Screen, one inch to two inches, inclusive:

(1) No. 4 to 1/2 maximum size mesh screen, inclusive.
(2) Over 1/2 maximum size to and including full maximum size mesh screen.

Within any of the above-indicated size-limits, not less than 85 percent of the material shall be retained on a standard square mesh screen of the minimum size indicated and not more than 5 percent shall be retained on a standard square mesh screen of the maximum size indicated.

(3) The grading of the coarse aggregate, in the mixed

concrete, shall fall within the following limites:

	(Per cent by weight) Passing
Maximum size mesh screen (square mesh)	97 - 100
1/2 maximum size mesh screen (square mesh)	40 - 70
No. 4 sieve	0 - 6

d. Tests. - (1) Coarse aggregate will be subjected to freezing and thawing tests and to careful, thorough analyses to determine conformity with all requirements of these specifications. Coarse aggregate will be subjected to 10 cycles of the magnesium sulphate test for soundness. No aggregate shall be used which develops a loss in excess of 10 percent by weight.

9-08. Material added for workability. - a. The use of any material added to the mix to improve workability (see Paragraph 9-06 c (2)), which, in the opinion of the contracting officer, may have an injurious effect on the strength, density, and durability of the concrete, will not be permitted. Before approval of any material, the contractor will be required to submit the results of complete chemical and sieve analyses made by an acceptable testing laboratory. Subsequent tests will be made of samples taken by the contracting officer from the supply of the material being used on the work to determine whether it is uniform in quality with that approved.

b. The material added shall be pozzuolanic, cementitious or silicious. It shall not contain effective early-heat-producing elements or compounds, such as those contained in Portland cement, nor shall its use result in a material increase in the free-lime content of the concrete. It shall also be in conformity with the following requirements:

Free moisture - a total of not more than 3 percent by weight.
Passing #30 sieve - not less than 100 percent by weight.
Passing #200 sieve - not less than 85 percent by weight.

9-09. Water. - The water used in mixing concrete shall be fresh, clean, and free from injurious amounts of oil, acid, alkali, or organic matter.

9-10. Storage. - a. Cement. - Immediately upon receipt, at the site of the work, cement shall be stored in a thoroughly dry, weathertight, and properly ventilated building with adequate provisions for the prevention of the absorption of moisture. The building shall be of adequate capacity to provide for the requirements of delivery and construction schedules. Storage shall be such as to permit easy access for inspection and definite identification of each shipment.

b. Aggregates. - The fine and coarse aggregates shall be

stored separately (see Paragraph 9-07 c (2))and in such manner as to avoid the inclusion of any foreign material in the concrete. Stockpiles of coarse aggregates shall be built in horizontal layers to avoid segregation.

9-11. Sampling and testing aggregates. - Except where provided otherwise by these specifications, all sampling and testing of aggregates shall be made in accordance with the Federal Specifications. Unless specified otherwise, all test samples shall be taken under the supervision of the contracting officer and supplied to the Central Concrete Laboratory, West Point, N. Y., by the contractor at his expense. The source from which concrete aggregates are to be obtained shall be selected by the contractor well in advance of the time when they will be required in the work, and suitable samples as they are to be used in the concrete shall be furnished to the contracting officer at least 30 days in advance of the time when the placing of the concrete is expected to begin.

PROPORTIONING, MIXING AND PLACING

9-12. Proportioning. - a. Basis. - All concrete materials will be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

b. Control. - The exact proportions of all materials entering into the concrete shall be as directed by the contracting officer. The contractor shall provide all equipment necessary to positively determine and control the actual amounts of all materials entering into the concrete. The proportions will be changed whenever in the opinion of the contracting officer such change becomes necessary to obtain the specified strength and the desired density, uniformity, and workability, and the contractor will not be compensated because of such changes.

c. Measurement. - All materials shall be measured by weight except that water may be measured by volume when so authorized by the contracting officer. One bag of cement will be considered as 94 pounds in weight and 1 gallon of water as 8.33 pounds.

d. Cement content. - Each cubic yard of concrete shall contain not less than the quantity of cement stated below:

Class "A"	-	5.0 bags or 470 pounds.
Class "B"	-	4.0 bags or 376 pounds.

For concrete deposited in water the minimum cement content shall be 6.5 bags or 611 pounds to each cubic yard of concrete in place.

e. Water content. - (1) In calculating the total water content in any mix the amount of moisture carried on the surface of the aggregate particles shall be included. The total water content per bag of cement for each batch of concrete shall not exceed the following:

Class "A" - 5.5 gallons or 45.8 pounds.
Class "B" - 6.5 gallons or 54.1 pounds.

In all cases, however, the amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix shall be that required for the specific placing conditions and methods of placement, and ordinarily the slump shall be between 1 inch and 3 inches when tested in accordance with the current specifications for "Method of Test for Consistency of Portland Cement Concrete," of the American Society for Testing Materials.

(2) An increase in the maximum water content, based only on the requirements of materials added in accordance with Paragraph 9-06 c (2) to improve workability will not be permitted unless comparative tests under job conditions show conclusively that such increase in water content will not result in a decrease in concrete strength and provided further that such increase does not exceed 1 gallon per cubic yard.

f. Aggregate content. - The total volume of aggregates to be used in each cubic yard of concrete shall be that necessary to produce a dense mixture of the required workability as determined by the contracting officer.

9-13. Mixing and placing. - a. Equipment. - The contractor shall provide at the site of the work a modern and dependable batch-type mixing plant with a minimum capacity of 150 cubic yards of concrete per 8 hours. The plant shall include not fewer than two complete mixers with separate power plants, having a minimum capacity of 3/4 cubic yards each. The equipment shall provide adequate facilities for the accurate measurement and control of each of the materials entering the concrete. The complete plant assembly, including provisions to facilitate the inspection of all operations at all times and the adequacy and dependability of each of its parts shall be subject to the approval of the contracting officer and shall conform to the following requirements:

(1) It shall be capable of ready adjustment for compensating for the varying moisture content of the aggregates and for changing the proportionate batch weights.

(2) It shall be capable of controlling the delivery of all material within 1 percent by weight of the specified amounts.

(3) It shall be arranged to permit the convenient removal of the material in excess of the specified tolerances.

(4) It shall include a visible dial or any suitable device which will accurately register the scale load at any stage of the weighing operations from zero to full capacity.

(5) The accuracy of the weighing equipment shall conform to the requirements of the U. S. Bureau of Standards and shall be tested monthly or otherwise when required at the expense of the contractor.

(6) It shall include a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanisms must be such that no leakage will occur when the valves are closed.

(7) It shall include a device for accurately and automatically measuring and indicating the time required for mixing, which may be interlocked to prevent the discharge of concrete from the mixer before the end of the mixing period.

(8) It shall include a device for properly recording and indicating the number of batches handled.

b. Time. - The minimum time for mixing each batch, after all materials are in the mixer, shall be as follows:

3/4 to 1-1/2 cu. yd. mixer	1-1/2 minutes
Larger than 1-1/2 cu. yd. mixer	2 minutes

The mixer shall revolve a minimum of 12 revolutions after all materials have been placed in it, and at a uniform speed. Neither speed nor volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive overmixing, requiring additions of water to preserve the required consistency, will not be permitted.

c. Conveying. - Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Conveying of concrete by means of chutes will not be permitted except for short chutes in the forms to distribute the concrete. Chutes used shall be such that the concrete slides in them and does not flow. Chutes with a flatter slope than 1 on 2 will not be permitted. There shall be no free vertical drop greater than 5 feet, except where specifically authorized by the contracting officer.

d. Placing. - (1) Concrete shall be placed before initial set has occurred, and in no event after it has contained its water content for more than 45 minutes.

(2) Unless otherwise specified, all concrete shall be placed in the dry upon clean, damp surfaces, free from ice, frost or running water, and never upon soft mud, dry porous earth, or upon fills that have not been subjected to approved rolling, puddling, or tamping so that ultimate settlement has occurred.

(3) Rock surfaces upon which concrete is placed shall be approximately horizontal or stepped, rough, and free from loose material or other matter interfering with a satisfactory bond. The rock shall be washed, scrubbed with steel brushes or brooms, and spread with a layer of mortar about 1/2 inch thick, immediately before the concrete is placed. The mortar shall be of the same cement-sand ratio as used in the concrete.

(4) All monoliths shall be of the dimensions shown on the drawings.

(5) All concrete shall be deposited in approximately horizontal layers not to exceed 24 inches in thickness unless otherwise specifically authorized or directed by the contracting officer and the concreting shall be carried on as a continuous operation, as far as practicable, until the placing in the course, section, panel or monolith is completed. Unless otherwise shown on the drawings and except for the spillway weir courses shall generally have a minimum thickness of 4 feet, and a maximum of 13 feet, except that in hot weather the contracting officer may direct the maximum be reduced to 8 feet. A minimum time interval of 48 hours shall be allowed between successive courses for the dissipation of heat of hydration. In walls of buildings, courses including door or window openings shall terminate at the tops of the openings. Concrete in the spillway weir shall be placed in courses having a maximum depth of 5 feet. A minimum time interval of 5 days shall be allowed between successive courses for the dissipation of heat of hydration.

(6) In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On flat surfaces, where the congestion of steel near the forms makes placing difficult, a mortar of the same cement-sand ratio as is used in the concrete shall be first deposited to cover the forms.

(7) All top surfaces not covered by forms and which are not to be covered by additional concrete or backfill shall be carried slightly above grade and struck off by board screed (see Paragraph 9-15), except that top surfaces of walls and piers not covered by forms and which are not to be covered by additional concrete or backfill, when poured in excess of 10 feet in height in one pour, shall be carried not less than 2 inches above the specified finished elevation and struck off by board screed.

c. Vibrating. - (1) Concrete shall be placed with the aid of mechanical vibrating equipment as approved by the contracting officer. Vibration shall be transmitted directly to the concrete, and except as provided in Paragraph 9-13 c (2) it shall not be transmitted through the forms. The frequency of vibration shall be not less than 5000 per minute. The intensity of vibration shall be sufficient to cause flow or settlement of the concrete into place. The vibration shall be of sufficient duration to accomplish thorough compaction as approved by the contracting

officer. Vibration shall be supplemented by forking or spading by hand adjacent to the forms on exposed faces in order to secure smooth, dense, even surfaces. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures.

(2) Where internal vibration is not practicable external vibrators shall be attached to or held on the forms in such a manner as to transmit the vibration to the concrete effectively and shall be raised in lifts as filling of the forms proceeds, each lift being not more than the height of concrete visibly affected by the vibration. They shall be placed horizontally at distances not greater apart than the radius through which the concrete is visibly affected.

(3) Vibration shall be supplemented by forking and spading by hand adjacent to the forms on exposed faces that cannot be effectively vibrated. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures.

f. Construction joints. - Vertical joints shall be formed at such locations and of such shapes and dimensions as shown on the drawings or directed by the contracting officer. Horizontal joints shall be formed with roughened level joints or with keys, or, where horizontal pressure is always in one direction, with steps as approved or directed by the contracting officer. Where required, dowel rods shall be used. All concrete in vertical members shall have been in place not less than 12 hours, and longer, if so directed by the contracting officer, before concrete in horizontal members resting thereon is placed. As soon as practicable after placing and immediately before placing the succeeding layers is resumed, all approximately horizontal surfaces shall be washed with a high pressure air-and-water jet or cleaned as otherwise directed by the contracting officer. Sand shall be added to the air-and-water jet when required, to remove alkali, algae, stains, and other substances injurious to the bond. The time and method of using the jet shall be such that all laitance, scum, etc., will be removed so that partly embedded aggregate is not disturbed and is washed clean. After final cleaning and immediately before placing is resumed, the surfaces shall be wetted and spread with a layer of mortar 1/2 inch thick, thoroughly brushed in. The mortar shall be the same cement-sand ratio as the concrete. Where specified or otherwise required by the contracting officer for water-tight construction, copper strips not less than 18 inches in width and weighing not less than 20 ounces per square foot, properly crimped or bent, shall be placed in the concrete to span the joint.

g. In water. - When specifically authorized, concrete may be deposited in water having a temperature above 45 degrees F. The methods and equipment used shall be subject to the approval of the contracting officer. When deposited by the tremie method, the tremie shall be watertight and sufficiently large to permit a free flow of concrete.

The discharge end shall be kept continuously submerged in the concrete and the shaft kept full of concrete to a point well above the water surface. When the bottom-dump-bucket method is used, the bucket shall not be dumped until after it has come to rest on the surface upon which the concrete is to be deposited. The bucket shall be provided with a suitable cover, and the bottom doors, when tripped, shall open freely. The bucket shall be completely filled and slowly lowered in order to avoid backwash, and when tripped it shall be slowly withdrawn until entirely free of the concrete. With either method, concreting shall proceed without interruption until the top of the concrete is well above the water surface.

h. Cold weather. - Concrete shall not be placed when the ambient atmospheric temperature is below 35 degrees F., nor when the concrete is likely to be subject to freezing temperatures before final set has occurred, unless specifically authorized by the contracting officer in writing. When so authorized, the materials shall be heated in order that the temperature of the concrete, when deposited, shall be not less than 50 degrees F. nor more than 70 degrees F. All methods and equipment for heating shall be subject to the approval of the contracting officer.

i. Hot weather. - For concrete placed during the extremely warm summer months and otherwise, when directed by the contracting officer, the aggregates shall be cooled by frequent spraying in such manner as to utilize the cooling effect of evaporation. During such periods the placement schedule shall be arranged as approved by the contracting officer in such manner as to provide time for the temperature of the previously placed course to begin to recede. The mixing water shall be the coolest available at the site in so far as is practicable.

9-14. Test specimens. - a. Number. - Test specimens, to determine whether the compressive strength of the concrete is in accordance with that specified in Paragraph 9-03, will be taken by the inspector. At least 1 set of 3 specimens will be made for every major pour and in general for every 500 cubic yards of concrete placed, but in any event, a sufficient number of specimens will be taken to give a comprehensive knowledge of the concrete placed during each day in each section of the work.

b. Method. - All specimens will be taken from the concrete at the mixing plant. The specimens will be tested by the Government at the Central Concrete Laboratory, West Point, N. Y. All costs of transportation and testing of specimens will be borne by the Government.

9-15. Finishing. - a. Immediately after placement, the concrete shall be properly forked back along the faces of all forms by the use of standard concrete forks or spades unless otherwise specifically authorized or directed by the contracting officer. The finished surfaces shall be free from sand streaks or other voids and the plastering

over of such surfaces will not be permitted. Defective concrete shall be repaired by cutting out the unsatisfactory material and placing new concrete which shall be formed with keys, dove-tails or anchors to attach it securely to the other work. This concrete shall be drier than the usual mixture and shall be thoroughly tamped into place. All surfaces of concrete, not covered by forms, that are not to be covered by additional concrete or backfill, shall have a wood float finish without additional mortar, and shall be true to elevations as shown on drawings. Care shall be taken to see that all excess water is removed before making this finish. Other surfaces shall be brought to the specified finished elevation and left true and regular as approved by the contracting officer. Where considered necessary by the contracting officer, or where indicated on the drawings, joints shall be carefully made with a jointing tool. Every precaution shall be taken by the contractor to protect finished surfaces from stains or abrasions. No fire shall be permitted in direct contact with any concrete at any time. Concrete surfaces, or edges likely to be injured during the construction period, shall be properly protected by leaving the forms in place, or by erecting covers satisfactory to the contracting officer.

b. Floor surfaces. - Unless otherwise specified, floors of all buildings, and other surfaces where indicated on the plans or required by the contracting officer, shall be finished with a one-inch monolithic sand-cement mortar surface. All water, laitance and any foreign matter shall be removed from surfaces. The topping mixture shall be spread evenly over the base within 45 minutes after the base has been placed. The mortar shall be of one part cement and two parts approved clean coarse sand. The cement and sand shall be thoroughly mixed dry and then sufficient water shall be added to produce a medium stiff mortar. After placing, the mortar shall be floated to a true, regular surface with a wood float and steel-troweled to a smooth finish. Troweling shall be the minimum amount consistent with obtaining a smooth dense surface and shall not be done until the mortar has hardened sufficiently to prevent excess fine material from being worked to the surface.

9-16. Curing. - a. Warm weather. - All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. All concrete shall be kept wet for a period of not less than 14 days by covering with water, or with an approved water-saturated covering, or by a system of perforated pipes or mechanical sprinklers, or any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall be generally clean and entirely free from any elements which in the opinion of the contracting officer might cause staining or discoloration of the concrete.

b. Cold weather. - Concrete when placed during cold weather shall be kept moist and provided with adequate protection for a period of not less than 14 days, subject to the approval of the contracting of-

ficer, so that the air in contact with the concrete will be maintained at temperatures between 50 degrees F. and 70 degrees F. for at least the first 5 days of the curing period. For massive sections, where the atmospheric temperatures are sufficiently low in the opinon of the contracting officer to cause excessively rapid cooling and contraction of the exterior surfaces, this period for maintaining the temperature of the air in contact with the concrete between 50 and 70 degrees F. shall extend over the entire curing period. Salt or other chemicals shall not be admitted into the mixture to prevent freezing except with the approval of the contracting officer

FORMS, REINFORCEMENT AND PAYMENT.

9-17. Forms. - a. Materials. - Forms shall be of wood, steel, or other approved material, except that where lining is not specified, the sheeting for all exposed surfaces shall be tongue-and-groove lumber of uniform width unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. The type, size, shape, quality and strength of all materials of which the forms are made shall be subject to the approval of the contracting officer.

b. Construction. - Forms shall be built true to line and grade, and shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports. Responsibility for their adequacy shall rest with the contractor. Their surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal will be not less than 2 inches from any concrete surface. Wire ties will not be permitted where the concrete surface will be exposed to weathering and discoloration will be objectionable. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges, at expansion joints or any other points as may be required by the contracting officer.

c. Coating. - Prior to the placing of steel reinforcement or concrete, forms for exposed surfaces shall be coated with a non-staining mineral oil. After oiling the forms the excess oil on the surfaces shall be removed by wiping with dry rags or waste. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete, except that in freezing weather oil shall be used.

d. Removal. - Forms shall not be removed without the approval of the contracting officer, and all removal shall be accomplished in such manner as will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum number of days indicated below, except when specifically authorized by the contracting officer.

When, in the opinion of the contracting officer, conditions on the work are such as to justify it, forms may be required to remain in place for longer periods.

Arches, beams and slabs	7 days
Columns	3 days
Walls and vertical faces	2 days

c. Form lining. - (1) In addition to the requirement for work specified above, wood forms for walls which will be visible in the finished outlet structure, and at other locations indicated on the drawings or directed by the contracting officer, shall be lined with plywood or with pressed wood sheets similar to Masonite or approved equal. Lining shall be applied directly to the sheeting. Forms for window and door jambs and their flat or arched soffits shall be lined with the corner intersections chamfered. The jointing of the lining shall be neat and close and no patch pieces, plugs, cleat, or blocking will be permitted. Overrun of lining shall be trimmed to secure proper fit to adjoining surfaces. Lining with bruises, imprints, or hammer marks shall not be used.

(2) Pressed wood sheets used for form lining shall be not less than 1/4-inch thick with a hard smooth surface on one side, and shall be specially processed to resist moisture. Sheets shall be of sizes as large as practicable to obtain a minimum number of joints. They shall be applied to the wood form construction with the smooth side against the concrete, and nailed so as to secure them properly, with all joints butted tight and bearing on solid construction. Bevels shall be formed of smooth straight-grained wood and shall be nailed through the lining into the backing. The lining shall be re-used only as many times as will insure a continuous smooth concrete finish.

9-18. Reinforcement. - a. General. - The contractor shall furnish and install all reinforcement, including rods, fabric and structural shapes, as indicated on the plans or otherwise required. All reinforcement shall be, when surrounding concrete is placed, entirely free from rust, scale, grease or other coating which might destroy or reduce its bond with concrete. Shop drawings, lists and bending details shall be furnished by the contractor when required.

b. Minimum spacing of rods. - The clear distance between parallel rods shall be not less than 1-1/2 times the diameter of round rods, or twice the side dimensions of square rods, and, unless specifically authorized, shall in no case be less than 1 inch.

c. Protective covering. - (1) All main reinforcement in walls and slabs of buildings exposed to the weather and in fire-resistant construction, shall be placed not less than 1 inch from the surface in walls and slabs, 1-1/2 inches in floor beams, and 2 inches in girders and columns. In interior flat slab construction, the minimum

cover may be reduced to 3/4 inch. For interior work where fire hazard does not exist, the main reinforcement shall be placed not less than 3/4-inch from the surface in walls and slabs, 1 inch in floor beams and 1-1/2 inches in girders and columns.

(2) The covering of stirrups, spacer rods, and similar secondary reinforcement may be reduced by the diameter of such rods. The above dimensions shall be measured from the face of the reinforcement to the face of the forms.

d. Splicing. - Where splices in reinforcement, in addition to those indicated, are necessary, there shall be sufficient lap to transfer the stress by bond, as may be directed. Rods shall be lapped not less than 40 diameters and splices shall be staggered. The lapped ends of rods shall be separated sufficiently or connected properly to develop the full strength of the rod. Adjacent sheets of mesh reinforcement shall be spliced by lapping not less than 6 inches, the lapped ends being securely wired together.

e. Supports. - All reinforcement shall be secured in place true to the lines and grades indicated, by the use of metal or concrete supports, spacers or ties as approved by the contracting officer. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation, and shall be used in such a manner that they will not be exposed on the face of nor in any way discolor nor be noticeable in the surface of the finished concrete. The costs of furnishing and placing all supports, spacers, ties and other devices required, shall be included in the contract prices for the various types of reinforcement specified.

f. Protection for future use. - Exposed reinforcement intended for bonding with future work shall be protected from corrosion by heavy wrappings of burlap saturated with bituminous material.

g. Grouting of anchor rods shall be done sufficiently in advance of the concrete operations to allow the grout to become thoroughly set. After preparing the holes (see Paragraph d-02), each hole shall be filled with cement grout and the anchor rod forced to the bottom of the hole. The grout mixture shall be composed of 1 part Portland cement and 2-1/2 parts sand by volume, combined with water to a suitable consistency, and shall be placed as approved by the contracting officer. Anchor rods which are found to be loose after the grout has set shall be replaced, as directed by the contracting officer, at the expense of the contractor.

9-19. Embedded items. - In addition to steel reinforcement, there shall be built into, or set, or attached to the concrete, gates, pipes, anchors, grilles, and other metal objects as shown on the drawings or ordered. All necessary precautions shall be taken to prevent these objects from being displaced, broken or deformed. Before placing con-

crete, care shall be taken to determine that any embedded metal or wood parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil, or any foreign matter. The embedding of wood in concrete shall be avoided whenever possible, metal being used instead. The concrete shall be packed tightly around pipes and other metal work so as to prevent leakage and secure perfect adhesion. Drains shall be adequately protected from intrusion of concrete into them. Payment for this work will be included in the contract unit prices for the items for drains and metal work.

9-20. Expansion and contraction joints. - Expansion and contraction joints shall be constructed at such points and of such dimensions as may be indicated or required. The method and materials used shall be subject to the approval of the contracting officer and the materials shall conform to Federal specifications wherever applicable. Unless otherwise indicated on the drawings, or required by the contracting officer, expansion joints shall be made by coating concrete surfaces with two coats of approved asphaltic emulsion or a single coat of bituminous cement. In no case shall corner protection angles or other fixed metal except copper water stops embedded in the surface of the concrete and bonded, be continuous through an expansion joint. Payment for all expansion joint material shall be included in the contract unit price for concrete.

9-21. Measurement and payment. - a. Portland cement (Item 28). - (1) The quantity to be paid for under Item 28 will be the number of barrels of cement used in all parts of the work unless specifically excepted. For purposes of payment, a barrel of cement shall be considered 376 pounds net of cement. The contract unit price for the cement shall include payment for all expenses incidental to delivering the cement upon the work in which it is to be used.

(2) Only the cement furnished for work to be done under Items 27, and 29 to 32 inclusive, will be paid for under Item 28. Cement used for mortar or grout under other items will be included in the payment for those items.

b. Concrete (Items 29 to 32 inclusive). - See Section X.

c. Reinforcement (Item 33). - (1) The quantity to be paid for under Item 33 will be the number of pounds of steel placed in accordance with the drawings or orders, measured as specified. It will not include any waste material due to the fact that the lengths supplied are too long for their purpose. The quantity paid for will, however, include extra metal in laps, where authorized, due to the fact that single bars would be unreasonably long. In computing the weights, the theoretical weight of plain bars will be used as tabulated in Federal Specification QQ-B-71a for the lengths placed as required. Wire or metal clips, and other supports necessary to hold the steel in place will not be considered as reinforcement but shall be furnished by the

contractor without additional compensation. The contract unit price for Item 33 shall include the furnishing, bending, cutting, placing, fastening in position, coating and protecting the reinforcement, and all other work and materials connected therewith (see Paragraph 9-18).

(2) Payment shall also include all costs of labor and materials required for grouting of anchors and dowels into rock or concrete and not specifically included under other items (see Section VIII).

(3) Partial payments up to 50 percent of the contract price will be made for all steel reinforcement delivered to the site of the work, provided the quality of such material is satisfactory to the contracting officer; but in no case will the payment to the contractor exceed the cost of the material delivered to the site of the work. The material shall be stored and kept protected from deterioration in a manner satisfactory to the contracting officer. If any steel reinforcement stored and partly paid for is not kept protected, no further partial payments will be made and the material will be protected by the contracting officer at the expense of the contractor.

9-22. Cinder concrete. - a. Where concrete is indicated as a filler in the roof of the operating house superstructure, it shall be mixed in the approximate proportion of 1 bags of cement to 2 cubic feet of sand and 4 cubic feet of cinders, mixed as required by the contracting officer. Test blocks of concrete shall be made by and at the expense of the contractor before the concrete is placed, to determine the correct proportions of the ingredients to obtain a cinder concrete of proper qualities for nailing and permanently supporting the roof surfacing. The cement and sand shall conform to the requirements for regular concrete herein. The cinders shall be coarse, clean and free from dust. The top surface of the concrete shall be given a smooth and even finish, and have a uniform slope to the gutters.

b. If so elected by the contractor and approved by the contracting officer, a substitute for cinders may be used. Any such substitute must be a commercial product of proven quality, prepared especially as a roof filler. When mixed and used as recommended by the manufacturer, the resulting product must have strength and nailing properties equivalent to that of cinder concrete and its unit weight shall not be in excess of that of cinder concrete of equivalent quality.

c. Payment for cinder concrete will be made under Item 34, "Operating House Superstructure."

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SECTION X. CONCRETE STRUCTURES (Items 29 to 32 incl.)

10-01. General. - a. Concrete structures shall be constructed as shown on the drawings and in accordance with the modifications designated by the contracting officer. Concrete shall conform to all the requirements of Section IX for concrete of the class specified. Surfaces of concrete shall be finished as specified in Paragraph 9-15, except as otherwise specified in this section or indicated on the drawings.

b. Measurement and payment. - (1) The quantity to be paid for under Items 29 to 32, inclusive, will be the number of cubic yards of concrete satisfactorily placed within the required limits. No deductions will be made for openings having a cross-sectional area less than that of a 12-inch pipe, nor for the space occupied by reinforcing steel, miscellaneous metal, wood nailing strips, or by other materials required to be built into the concrete. The contract unit prices shall include payment for all costs of furnishing materials, erecting and removing forms, mixing and placing concrete, except that cement, reinforcing steel and other metal work are included under other items. (See Paragraph 9-21.)

(2) Where concrete adjoins rock excavation the quantities to be paid for will be measured to the rock surface against which the concrete is placed; provided that this rock surface does not lie outside the tolerance line determined by the contracting officer for the rock excavation, as provided in Paragraphs 4-09 d(2) and 4-10 c. If at any point the excavation has been made beyond this tolerance line, measurement for payment for concrete will be made only to the tolerance line, but the contractor, at his own expense, shall fill such excess excavations with concrete. (See Paragraph 4-01 d(2)).

10-02. Class "A" concrete - Inlet and outlet channel lining and gate structures (Item 29). - a. Description. - This classification includes the Class "A" concrete placed in the inlet and outlet channel lining, and the gate structure, and any other Class "A" concrete not specifically included under any other contract item. The forms for the water passages and for exposed exterior surfaces shall be lined in accordance with the requirements of Paragraph 9-17 e. Piping and other metal work shall be set and concreted in place.

b. Measurement and payment. - Measurement for payment will be made as provided in Paragraph 10-01 b. Payment will be made at the contract unit price for Item 29, "Class "A" Concrete-Inlet and Outlet Channel Lining and Structures".

10-03. Class "B" concrete - Outlet works retaining walls. (Item 30). - a. Description. - This classification includes the Class "B" concrete placed in the outlet works retaining walls between the limiting lines and grades and in the locations shown on the drawings or directed by the contracting officer. Forms for the exposed surfaces shall be lined in accordance with the requirements of Paragraph 9-17 c. Piping and other metal work shall be set and concreted in place.

b. Measurement and payment. - Measurement for payment will be made as provided in Paragraph 10-01 b. Payment will be made at the contract unit price for Item 30, "Class "B" Concrete-Outlet Works Retaining Walls".

10-04. Class "A" concrete - Road and bridge structures (Item 31). - a. Description. - This classification includes the Class "A" concrete for bridge floor, abutments, and other details, and for culvert headwalls, placed between the limiting lines and grades and in the locations as shown on the drawings or directed by the contracting officer. Forms for exposed surfaces shall be lined in accordance with the requirements of Paragraph 9-17 e. Corrugated metal pipe and other culverts shall be installed as shown on the drawings.

b. Measurement and payment. - Measurement for payment will be made as provided in Paragraph 10-01 b. Payment will be made at the contract unit price for Item 31, "Class "A" Concrete-Road and Bridge Structures".

10-05. Class "B" concrete - Spillway weir (Item 32). - a. Description. - This classification includes the Class "B" concrete for the spillway weirs placed between the limiting lines and grades and in the locations as shown on the drawings or directed by the contracting officer. Forms for exposed surfaces shall be lined in accordance with the requirements of Paragraph 9-17 e.

b. Measurement and payment. - Measurement for payment will be made as provided in Paragraph 10-01 b. Payment will be made at the contract unit price for Item 32, "Class "B" Concrete - Spillway Weir."

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SECTION XI. OPERATING HOUSE SUPERSTRUCTURE (Item 34).

11-01. Work included. - a. The contractor shall furnish all labor and materials and do all work required to construct the operating house superstructure as shown on the drawings or ordered. The work includes the furnishing and installing of all structural steel, masonry, cement, door frames, doors, builders' hardware, roofing, and any other work, materials and labor not specifically mentioned that are necessary to complete the operating house superstructure in the finished condition as shown on the drawings or ordered.

b. The bronze plaque for the front or south exterior of the operating house will be furnished by the Government and shall be set by the contractor, as indicated on the drawings.

11-02. Structural steel. - a. All structural steel, including roof beams, columns, column bases, sway bracing, entrance and service door channel frames, crane girder, crane rails, rail hook bolts and other metal work of similar character shall be furnished and erected as indicated on the drawings. Before commencing fabrication the contractor shall submit for the approval of the contracting officer in accordance with Paragraph 1-04 c prints in quadruplicate of shop and erection drawings showing all details proposed. The structural steel shall be new unrusted stock, open-hearth steel of uniform quality; it shall meet the requirements of "Federal Specification QQ-S-711a, August 27, 1937." The workmanship on structural steel shall be equal to the best practice of modern shops. Material shall be straightened, by methods that will not injure it, before being laid out or worked in any way. All portions of the work exposed to view shall be neatly finished. Structural steel work shall be riveted as far as practicable at the shop, and erected in place on the work in accordance with approved standard practice. Rivets shall be driven hot, and wherever possible by power tools. Rivet heads shall be full, neatly finished, concentric with the holes, and of uniform size throughout the work for the same size rivet. Rivets after driving shall be tight, completely filling the holes, with the heads in full contact with the surface of the member.

b. The structural steel channel door frames for the entrance and service doors shall be furnished and installed as shown in detail on the drawings. The mitre joints shall be welded and ground smooth; each side of the entrance door frame shall be provided with 6 adjustable steel anchors, and each side of the service door frame with 4 adjustable steel anchors, attached to the channel frame as shown. The steel plate striking bars shall be attached as shown. The frames shall be constructed and assembled complete in the shop.

c. All structural steel work, before leaving the shop, shall be thoroughly cleaned of all loose scale and rust and given one good coat of red lead paint well worked into all joints and open spaces. The

surfaces coming in contact shall be painted before being assembled for riveting. Pieces and parts which are not accessible for painting after erection shall have two coats of paint (see Section XVII). Metal to be embedded in concrete shall be unpainted and shall be kept free from rust as specified for reinforcing steel in Paragraph 9-13. Any scaly or heavy rust, loose mill scale, or grease shall be removed just before embedding in concrete.

11-03. Brick masonry. - a. All brick shall be whole, sound, straight, hard, uniform in structure, with true, even faces and sharp edges; and shall be uniform in shape for their respective kinds. Brick for filling and backing shall be of the first quality common building brick, conforming in all respects to Federal Specification SS-B-656, standard size 2-1/4 by 3-3/4 by 8 inches.

b. All exposed faces of the interior shall be built of first quality common building brick conforming to Federal Specification SS-B-656, standard size 2-1/4 by 3-3/4 by 8 inches.

c. All exposed faces of the exterior except where otherwise noted, shall be built of first quality, red, face brick similar or equal in color and texture to "Washington Colonials" of the Hydraulic Press Brick Company, St. Louis, Missouri.

d. Samples of all types of brick the contractor proposes to use shall be submitted for the approval of the contracting officer.

e. Cement lime mortar shall be composed of one part cement, one-half part lime putty, and three parts sand by volume. All mortar used for laying brick shall be thoroughly mixed either by hand or in a mechanical batch mixer. Mortar shall be prepared in such quantities that it can be used entirely before it has attained its initial set. The use of a continuous mixer or the use of a retempered mortar will not be permitted. The minimum amount of water sufficient to make a workable mortar shall be used. All lump lime shall be thoroughly slaked and shall not be mixed into mortar until it has stood for at least 48 hours after the initial slaking process has been completed.

f. All sand used shall be clean, coarse and silicious free from loam, clay and other foreign materials; and shall pass a No. 8 standard mesh screen. Sand used in mortar for the backing and filling brick shall be natural sand. Sand used in mortar for the interior and exterior face brick shall be natural white or clear sand, a sample of which shall be submitted for the approval of the contracting officer. Sand shall conform to the requirements of Paragraph 9-06, except as otherwise required.

g. Lime shall conform to Federal Specification SS-L-351 for hydrated Lime, Type "M". Lime shall be stored and protected in the manner specified for Portland cement.

h. Cement used in the mortar shall conform to the requirements of Paragraph 9-05, unless otherwise approved by the contracting officer.

LAYING BRICK

i. (1) All brick masonry shall be accurately laid in courses as indicated on the drawings. All exposed surfaces shall be laid to lines that are plumb, true, straight, and level. Each brick shall be laid in a full bed of mortar and shall be shoved into place in the mortar, making joints that are full without subsequent flushing or filling. Except where otherwise indicated on the drawings, the brick course including mortar joint shall be 2-5/8 inches high, and the joints shall be struck flush. Vertical and horizontal mortar joints shall have the same thickness. The mortar joints of exposed common brickwork shall be flush struck. Except where otherwise indicated, all exposed faces of brickwork shall be laid in American bond, with stretches bonded every sixth course by a course of alternate stretchers and headers. Metal wall ties shall not be used for the bonding of brickwork, except where indicated on the drawings or authorized by the contracting officer. The waterproofing membrane shown on the drawings at the foundation of the brick walls shall be similar and equal to the Sandell Through-Wall Flashing manufactured by Sandell Manufacturing Corp., 70 Phillips Street, Watertown, Mass.

(2) The courses shall be laid to correspond exactly in height with the heads of doors and other openings without any cutting or chipping of the brick. Door frames and all other fixtures shall be built into the brickwork as it is laid. Brick masonry around door openings shall have jambs built true and plumb with the reveals at right angles and of the depth shown on the drawings; and the brickwork shall either be kept back a sufficient distance or raked out to permit a calked joint as indicated on the drawings. The filling in or backing brickwork shall be kept level with the facing and each piece of facing material shall be backed up solid with brick and mortar so as to make a perfectly bonded homogeneous mass between wall lines. All walls shall be carried up together as nearly as possible on the same level. If during construction, the walls become displaced, damaged, or marred, by the contractor or his workmen, the contractor shall without additional compensation execute all patching and repairing necessary to leave the entire work in perfect condition. The placing of put-logs in masonry walls is prohibited. The contractor shall place boards over all window sills and projecting stone or water tables during construction.

(3) Care must be taken that the tops of all unfinished work are thoroughly covered or protected against inclement weather, by means of waterproof canvas and boards. Bricks laid in warm weather shall be kept wet before laying and shall be wet when laid. Bricks laid in cold weather shall be laid dry and warm. In winter the brick, sand, water, and other materials shall be kept warm and if required by the contracting

officer, shall be heated by steam pipes or other approved methods in order that the work shall proceed properly. The brickwork shall be carefully covered and protected to prevent freezing.

(4) The contractor shall carefully set or build in all door frames, anchors, beams, bolts, or other iron work, bronze, or other incidental materials; and shall build all recesses and pipe chases, as indicated on the drawings, or directed by the contracting officer.

(5) After completion, all brickwork shall be cleaned and pointed where necessary. Before pointing, the joints shall be raked out, cleaned and well moistened. The calking around all door frames and glass block panels shall be carefully checked, and the joints recalked where necessary.

(6) The dimensions of the brickwork shown on the drawings may be varied slightly depending on the size of the brick used.

11-04. Chimney. - The chimney shall be corbeled above the crane rail as shown on the drawings. It shall be lined from the bottom to the top with rectangular fire-clay terra-cotta flue lining of nominal size 8-1/2 by 18 inches. The joints shall be well cemented and struck smooth inside. A suitable cast-iron clean-out door and thimble of size indicated on the drawings shall be installed in the base of the chimney. The chimney shall be topped with a precast cement cap as indicated on the drawings.

11-05. Stonework. - a. All stone work shall be of light grey cast ornamental stone, and shall be placed as indicated on the drawings. The stone shall be uniform in color, sound, and perfect throughout; and subject to inspection before being placed in the work. All exposed surfaces shall have a rubbed finish. The cast stone shall conform in all respects to Federal Specification SS-S-721, for architectural cast stone, Type 1. The contractor shall submit samples of the precast stone proposed to be used, for the approval of the contracting officer. Samples shall not be smaller than 8 by 12 inches. The contractor shall also submit evidence satisfactory to the contracting officer that the manufacturer who will furnish the cast stone has had at least 10 years' experience in designing and manufacturing cast stone of satisfactory appearance and durability.

b. Before purchasing the stone, the contractor shall submit, in accordance with Paragraph 1-04 c for approval of the contracting officer, prints (in quadruplicate) of drawings showing in detail the sizes, coursing, and full details of trim.

c. The casting, sizing, and coursing of all cast stone shall be done in accordance with the approved detail drawings. The stone shall be dressed and finished to a clean, smooth, uniform surface. Washes shall be cast or cut on the tops of copings, and drips on the undersides of projections where indicated on the drawings. All arrises shall be

sharp and true. Anchors, cuts for accommodating steel work, and other incidental details shall be provided as required. Holes and sinkages shall be cast or cut in stones for all anchors, clamps, dowels, etc. Lewis holes shall be cut or cast in stones weighing more than 100 pounds. Lewis holes or other holes shall be not closer than two inches to exposed faces of stone, and holes on exposed faces of stone are prohibited. The cast stone shall be made to check in dimension with all adjoining brickwork.

d. Mortar for setting the cast stone shall consist of one part Portland cement, three parts fine white sand, and 10 percent by volume of hydrated lime.

SETTING STONE

e. (1) Just before setting each stone shall be brushed clean and thoroughly drenched with clean water. The stone shall then be accurately set, by competent stone setters, true to line and level, with full flushed joints. Each stone shall rest on a full bed of mortar placed under the center of the stone; the amount of mortar being sufficient to fill out to the edges of the stone on all sides. All stone shall be set with 1/4-inch joints raked out at the face to a depth of one inch and left for future pointing. The backs of stone facings shall be pargeted with neat cement where shown on the drawings. Where required in connection with the setting of heavy stones and projecting courses, in order to arrest the squeezing out of mortar beds, tipping or uneven setting of the stone; and wherever required in connection with stone bedded on structural members, to prevent cracking or spalling from unequal pressure, the contractor shall provide and install lead pads or buttons. These pads or buttons shall be made of soft sheet lead, either round or octagonal in shape, and of the same thickness as mortar joints. They shall be set not less than one inch back from the face of the stone, and have the mortar spread around them. Wherever practicable, heavy stones shall be set with derricks and lifted with Lewis plugs or hoisting loops. Where Lewis plugs or hoisting ropes cannot be used, the stone shall be set with clamps. The use of pinch bars, except on the embedded parts of the stones, is prohibited. No defective stone, and no broken spalled, patched, or otherwise damaged stone shall be set in place. Rejected material shall be promptly removed from the work area.

(2) The contractor shall furnish and install all necessary anchors and dowels, as indicated on the drawings or as required by the contracting officer. Dowels shall be coated with an approved dampproofing paint before being used. Adjustable anchors in slots shall be of brass, not less than 3/16 inch thick, and shall be set one inch back from the face of the stone.

(3) The contractor shall protect all cast-stone work from damage of every description until all construction work is completed. Any damaged work shall be replaced at the contractor's expense.

(4) After the stone has been set, all work shall be gone over by a competent stone mason, thoroughly cleaned, and all joints brushed clean, soaked with clean water, filled solid with pointing mortar, and dressed. The use of wire brushes, or acids and solutions which might cause discoloration will not be permitted in cleaning stone.

(5) The mortar for pointing stone work shall consist of one part white "Medusa" cement or equal, two parts white sand, and 10% by volume of hydrated lime. The mortar shall be colored as directed by the contracting officer.

ALTERNATE

f. (1) As an alternate the contractor may propose natural granite in lieu of the cast stone specified above. Granite shall be of a selected quality and a uniform light shade of gray with little hornblende in its composition. The contractor shall submit samples (not smaller than 8 by 12 inches) of the granite proposed to be used, for the approval of the contracting officer.

(2) The specifications for stonework as set forth above shall apply, as applicable, to the alternate stonework providing it is accepted in lieu of the cast stone.

11-06. Glass block. - a. Glass block panels shall be installed as shown on the drawings. The blocks shall be hollow, partially evacuated, water clear units of pressed glass construction of the best quality, similar and equal to the Series No. 300 of Owens-Illinois Glass Company, Toledo, Ohio. Unless otherwise shown on the drawings all glass block shall have a standard size of 7-3/4 by 7-3/4 by 3-7/8 inches. A sample of the type of glass block the contractor proposes to use shall be submitted for the approval of the contracting officer.

b. Laying of block. - (1) Each block shall be set in a 3/16-inch to 1/4-inch layer of mortar composed of one part Portland cement, one part lime and four parts sand by volume. Glass blocks shall be laid true to line and grade. Both head and bed joints shall be completely filled with mortar; after the mortar has reached its initial set the joints on both surfaces shall be compressed and pointed with a metal pointing tool, leaving the finished surface of the joint smooth and nonporous. Blocks shall not be cleaned until mortar has reached its final set.

(2) Horizontal mortar joints shall be reinforced with 20-gauge perforated metal wall ties 2-3/8 inches wide and of a length suitable for the glass block panel, galvanized after forming. Ties shall be placed every third course.

(3) Expansion joints shall be provided at the head and jambs of all glass block panels, and elsewhere as shown on the drawings.

All joints at head and jamb of panels shall be kept free from mortar and free from the transmission of structural loads carried by adjacent masonry. Expansion joints shall have a minimum thickness of 3/4-inch, and shall consist of 1/2-inch premolded waterproof expansion joint filler and a minimum of 1/4-inch of mortar between the glass block and filler. Asphalt asbestos felt shall be installed as shown on the drawings. The premolded filler shall be placed continuously on the back of the masonry "chase" at the head and jambs of the window. It shall be installed before the glass block is laid and shall be held in place by an adhesive such as asphalt emulsion. After the panels have been laid and the mortar has set, non-staining oakum shall be caulked between the sides of the block and the sides of the "chase" to within 1/2-inch of the finished surface. The 1/2-inch recess shall be filled flush with the finished surface with non-hardening waterproof caulking material similar and equal to "Vulcatex" manufactured by A. C. Horn Company, Long Island City, N. Y., or other approved elastic (or mastic) compound as shown on the drawings.

11-07. Doors. - a. Doors shall be of the type and design shown on the drawings. The contractor shall submit to the contracting officer, shop drawings showing the details of all doors in accordance with the provisions of Paragraph 1-04 c.

b. The entrance door shall be of the vertical, double-swinging, ornamental type, supported at the jambs with butts as shown on the drawings. Stiles and rails shall be constructed of rectangular steel tubing, internally reinforced at all corners and joints. All mitre joints and butt joints shall be welded and ground smooth. The metal panels shall be not less than 1/16 inch thick. The quality of the material and workmanship shall in all respects be equal to the corresponding product of the Atlantic Metal Product Co. Inc., Long Island City, N. Y. Bronze weather stripping as indicated on the drawings shall be equal to the product of the Chamberlin Metal Weatherstrip Company.

c. The service door shall be of the vertical swinging industrial type, supported at the jambs with butts as shown on the drawings. The door shall be of hollow steel construction. The quality of the material and workmanship shall, in all respects, be equal to the corresponding products of William Bayley, Springfield, Ohio, or the Truscon Steel Company, Youngstown, Ohio. Bronze weather stripping as indicated on the drawings shall be equal to the product of the Chamberlin Metal Weatherstrip Company.

d. The doors shall be painted and finished at the shop in the color to be selected by the contracting officer. The doors shall be cleaned and primed with one coat of approved rust resistant paint baked on, and one coat of mineral filler shall be baked on and rubbed before assembling. The doors shall be finished with two additional coats, baked on, the last coat being of the color selected. If the paint on the doors is marred in transmit or during installation, the finish shall be replaced at the contractor's expense to the satisfaction of the contracting officer.

11-08. Door frames. - As shown on the drawings, the doors shall be provided with a suitable cast-bronze saddle, properly fitted and secured in place with expansion bolts. All door frames shall be made of steel, accurately fitted, welded, and anchored in place as shown on the drawings. Loose lintels, as indicated on the drawings, shall have not less than 6 inches of bearing at each end.

11-09. Builders' hardware. - a. The contractor shall furnish and install heavy bronze hardware for all doors, including locksets, butts, chain bolts, floor and wall bumpers, clamps, stops or checks, and all other details of a complete installation. The inactive leaf of the entrance door shall have two pair butts, one long-chain bolt at top and one foot bolt. The active leaf shall have two pair butts, one lock, one foot bolt, and one door check. Other doors shall be hung on 1-1/2 pair butts and be equipped with lock sets, door checks, and stops.

b. The hardware shall be secured in place with machine screws and reinforcing plates shall be provided where necessary. Grouting around the foot bolt keepers in the floor shall be brought flush with the top. The hardware shall be subject to approval of the contracting officer, shall be of the heavy, solid bronze type, and of sufficient strength and size for the use intended. It shall conform to Federal Specifications, FF-H series, where applicable, and shall be similar and equal to the following products of the P. F. Corbin Company and the Stanley Company:

Butts	-	Stanley BB 199 (6 x 6)
Foot bolts	-	Corbin BB 4250-1/2 - 8"
Chain bolts	-	Corbin BB 4252-1/2 - 8"
Lock	-	Corbin BB 742-991
Door check	-	Corbin BB 105-1/2

11-10. Roofing. - a. Deck. - The roof slab and scuttle shall be of concrete as indicated on the drawings and shall conform to the requirements for Class "A" concrete as specified in Section IX. Before taking its initial set the concrete shall be struck off approximately to grade and then roughened with a rake. When directed by the contracting officer or in any event not less than 48 hours after the slab has been poured the contractor shall thoroughly clean the slab, dampen it, and place a filler slab of cinder concrete (see Paragraph 9-22) to the lines and grades indicated on the drawings. This slab of concrete shall be struck off and wood float finished to a reasonably smooth surface. Forms and shores under the roof slab shall not be removed or disturbed in less than 14 days after placing of the cinder concrete and only then upon specific authorization of the contracting officer.

b. Covering. - The roof shall be covered with a four-ply built-up tar and gravel roofing, "Barrett Specification, Type AA" or equal, furnished and installed under the direction of the manufacturer in strict accordance with his specifications subject to the approval of the contracting officer. Roofing shall extend up on the parapet walls and be flashed as indicated on the drawings.

c. Scuttle and drains. - Brass roof drains (with down spouts) shall be furnished and installed at the locations indicated on the drawings and shall be of the type and equal to the product of the Josam Manufacturing Company, of Cleveland, Ohio, as indicated by their catalog No. 414-S. A scuttle cover shall be provided and installed as shown on the drawings. The above catalog reference is given for descriptive purposes only.

d. Flashing. - All flashing, as indicated on the drawings or otherwise required, except where otherwise indicated, shall be 16-ounce copper, conforming in all respects to Federal Specifications QQ-C-501, Type V, Class "A". Seams shall be flat locked with 5/8-inch finish, and proper provision made for expansion. An approved saturated fabric shall be used around the roof slabs as shown on the drawings.

e. Downspouts. - Downspouts shall be made of galvanized, hand-puddled wrought-iron pipe with galvanized, malleable iron fittings. The pipes shall be securely anchored to the wall and shall extend through the floor as indicated on the drawings. (See Paragraph 12-02 for pipe material specifications.)

11-11. Electrical equipment and wiring. - The contractor shall install the lighting and power system under Item 41.

11-12. Built-in materials. - All anchors, sleeves, plates, ducts, door frames, thimbles, conduits, outlet boxes, drain pipes, vents, etc., necessary for the completion of the work shall be built in and carefully grouted and calked or buried as the case may be. The ventilating louvres shown on the drawings shall be Beco Adjustable Louvres as manufactured by H. W. Bergman and Co., 126 Nassau Street, N. Y.

11-13. Painting. - a. Painting shall be done only on surfaces which are thoroughly dry and clean. All metal to be exposed in the finished work shall be thoroughly cleaned and then thoroughly and evenly painted with two coats of approved paint to the satisfaction of the contracting officer. No painting shall be done until the condition of the surface to which the paint is to be applied has been approved. All field painting shall be done as specified in Section XVII.

b. For cleaning and painting of structural steel refer to Paragraph 17-03; for painting of entrance doors refer to Paragraph 11-07.

c. Two coats of approved paint shall be applied to all exposed metal work, and the gray finish coat shall match the finish color of the entrance doors (see Paragraph 11-07). The paint used shall conform to Federal Specification of Group "TT". Samples of paint shall be submitted to the contracting officer for approval and selection.

11-14. Installation of crane, gate hoists and standby unit. - The contractor shall install the traveling crane, gate operating hoists, and

tion runs of ana- Historically, the Connecticut River has supported the

standby unit. The contractor shall install the miscellaneous metals, including suitable dowels and anchors for anchorage of the concrete base of the standby unit to the floor of the operating house. Payment for this work will be made at the applicable contract unit prices therefor (see Paragraph 1-05).

11-15. Protection of work. - The contractor shall be responsible for damage to the operating house from the time that he begins work and until the work is accepted. He shall provide a watchman at the site at such times as the condition of the building so requires, and the building shall be kept locked when no work is being done in it. Temporary doors or screens for all openings shall be furnished and installed to keep out the weather when and where directed. Care shall be taken to prevent material or debris of any sort falling into the shafts. All of the work shall be thoroughly cleaned and swept at completion, and all glass shall be washed, leaving the building clean and ready for use.

11-16. Payment. - a. The dividing line between the operating house superstructure and gate structure shall be the floor at Elevation 864.5, with the following exceptions: The concrete and steel reinforcement in the curbs, between Elevations 864.5 and 868.5, shall be included in Items 29 and 33; the rails and fastenings around gate wells shall be included in Items 35 and 36; portions of door frame and anchor bolts below Elevation 864.5 shall be included in Item 34.

b. The contractor will receive for all work, materials and incidentals required to construct satisfactorily the operating house as specified, the lump sum contract price for Item 34. One-half of the sum will be included in estimates for payment as soon as the superstructure is satisfactorily walled and roofed and doors and windows installed so that it can be made satisfactorily weather-tight. The other half will be included in the final estimate.

c. Cement used for mortar or grout for the operating house superstructure shall be included in the lump sum contract price for Item 34.

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SECTION XII. METALS AND EMBEDDED ITEMS (Items 35 to 40 incl.)

12-01. General. - a. All metals, unless otherwise specified, shall conform to applicable Federal Specifications, and, when not covered thereby, to applicable A.S.T.M. specifications. All castings shall have the pattern or mark number cast on them. Unless otherwise authorized by the contracting officer, the scale weights of each casting or forging after machining shall be within 5 percent of the weights as calculated from the dimensions specified or shown on the drawings. Wherever used in these specifications, the word "ton" shall mean two thousand pounds. Castings shall conform, at the minimum section thereof, to the following dimensional tolerances: where embedded in concrete, to within 1/8 inch; where not embedded in concrete, to within 1/16 inch of the dimensions shown on the drawings.

b. The various articles shall be furnished and placed as indicated on the drawings. The more important articles required are listed below and are required at the gate structure and the operating house or elsewhere, but other metal items, whether or not shown on the drawings, becoming necessary in the development of detailed plans and satisfactory construction, shall also be furnished at the applicable contract unit prices specified in this section; except materials and fittings specifically included for payment under other items of the work.

12-02. Materials and workmanship. - a. The articles included in Items 35 to 40 inclusive, other miscellaneous materials, and all metals required in the work except as otherwise specified, shall meet the requirements of the following specifications where applicable to the use intended:

(1) Steel reinforcement shall be of new billet, intermediate grade, open-hearth steel, deformed. All reinforcement shall conform to the Federal Specification QQ-B-71a for "Bars, reinforcement, concrete, Type "B", Grade 2 (dated January 12, 1938)." Certified copies of any mill test required shall be furnished by the contractor and the steel shall be subjected to such tests as the contracting officer may consider necessary to establish its quality, including particularly the requirements of bending and elongation. The steel shall be free from oil, paint, dirt or excessive rust.

(2) Structural steel:- Paragraph 12-02 of these specifications and Federal Specification QQ-S-711a: shapes, plates, bars, pins and bolts shall be Class "A" and rivets shall be Class "C", unless otherwise required. Welding will be accepted only where specified or authorized, and approved only when done in accordance with the current requirements of the American Bureau of Welding.

(3) Cold-rolled steel:- A.S.T.M. Specifications A-108-36 for "Commercial Cold-Finished Bar Steels and Cold-Finished Shafting." Unless otherwise specified this material shall be used for rods, pins, keys and similar parts.

raised. Therefore, no significant effect on water temperature is antici

(4) Hot-rolled steel, for shafting, sleeves and rollers:- A.S.T.M. Specifications A-107-36 for "Commercial Quality Hot-Rolled Bar Steels."

(5) Machine steel, same as for Hot-Rolled Steel.

(6) Steel, corrosion resisting:- Federal Specification QQ-S-766.

(7) Steel forgings, shall be of hot-rolled open-hearth steel forging bars conforming to A.S.T.M. Specifications A-18-30 for carbon steel and alloy steel forgings, Class "C", except that shafts of this material not otherwise specified shall be S.A.E. No. 1045 hot-rolled, open-hearth steel forging bars.

(8) Steel castings:- Federal Specification QQ-S-681a.

(9) Iron castings, gray:- Federal Specification QQ-I-652 (dated April 4, 1939) class as indicated. Tensile tests and chemical analyses will not be required.

(10) Iron castings, semi-steel:- Federal Specifications QQ-I-656 for "Iron Castings, High Test (semi-steel)", class as indicated. Tensile tests will not be required.

(11) Malleable iron castings:- Federal Specification QQ-I-666, Type "A".

(12) Steel rail track and fittings, shall be standard A.S.C.E. sections and shall conform to the A.R.E.A. standard specification for carbon steel rails.

(13) Chains and attachments:- Federal Specification RR-C-271 of Type "A" and Grade "2" unless otherwise specified.

(14) Bolts, screws, and washers:- Appropriate Federal Specification and current standard practice, unless otherwise specified.

(15) Wrought-iron bars and shapes:- Federal Specification QQ-I-686, Grade "B".

(16) Wrought-iron pipe:- Federal Specification WW-P-441, Class A.

(17) Black steel pipe:- Federal Specification WW-P-403, Type A, and WW- P-521.

(18) Sheet metal:- Federal Specification QQ-I-696, Type II, Class A.

(19) Bronze:- Appropriate Federal Specifications QQ-B-746, QQ-B-691, QQ-B-726, QQ-B-611 and QQ-C-591.

(20) Brass castings:- Federal Specification QQ-B-621, Composition "B".

(21) Brass pipe:- Federal Specification WW-P-351, Grade A, and WW-P-448.

(22) Commercial brass:- Federal Specification WW-B-611.

(23) Sheet copper:- Federal Specification QQ-C-501, Type V, Class A.

(24) Zinc coatings (hot galvanized):- Federal Specification QQ-I-696.

(25) Babbitt metal:- Federal Specification QQ-M-161.

(26) Lead:- Federal Specification QQ-L-171, Grade A.

(27) Solder:- Appropriate Federal Specifications QQ- S-571 and QQ-S-551.

(28) Valves:- Federal Specification WW-V-76a.

(29) Other items, unless otherwise specified, shall conform to current standard practice for the material required and use intended.

12-03. Galvanizing. - Galvanized iron or steel articles as indicated on the drawings, shall be galvanized by the hot process unless otherwise permitted. Injuries to the galvanizing shall be satisfactorily repaired at the contractor's expense. Provision shall be made for protecting threads either by counter-boring fittings, so as to cover threads or by cutting threads so as to make a very loose fit before galvanizing and carefully rerunning threads after galvanizing so as to leave a good coating all over threads. Hot galvanizing shall be of such quality as to endure at least 4 immersions in copper sulphate solution.

12-04. Furnishing and erecting miscellaneous structural steel (Item 35). - a. Grilles, frames, and gratings shall be furnished and installed. General requirements are as follows:

(1) Grilles shall be detachable. At each anchor a hole shall be drilled and tapped for receiving 1/2-inch cap screws used in fastening the grille to the frame. The cap screws shall be of brass or bronze but furnished with the grilles and frames.

(2) Gratings shall be Irvings Steel Flooring, Type "O", or equal. Plate covers shall be of non-skid steel plates, reinforced and provided with hand holes.

b. Payment will be made as specified in Paragraph 12-09 b.

12-05. Furnishing and installing miscellaneous iron and steel (Item 36). - a. Ladder rungs, guard chains, pier nosings, anchors, and malleable iron pipe fittings and connections, shall be furnished and installed. General requirements are as follows:

(1) Ladder rungs, and hand grabs shall be of wrought iron, shop bent or manufactured.

(2) Steel guard chains and posts installed around the openings to service gate wells shall be portable; eye bolts and snaps shall be of forged steel.

(3) All miscellaneous anchors shall be hot-dip galvanized after bending and welding.

(4) Malleable iron pipe fittings and connections shall be ball pattern and pin connected, where required; post connections at the floor, and caps used on the bottoms of sleeves embedded in the concrete or on top of chain guard posts shall be standard screw-type. All fittings shall be of Crane Co. type or equal. Floor or wall flanges of screw type shall be anchored into the concrete with stud type expansion bolts consisting of a primary and one secondary expansive unit similar or equal to that manufactured by Ackerman-Johnson Company.

b. Payment will be made as specified in Paragraph 12-09 b.

12-06. Furnishing and installing miscellaneous wrought-iron pipe (Item 37). - a. Leader pipe to the gage well, and hand railing shall be furnished and installed. The leader pipe to the gage well shall be a 3-inch hand-puddled wrought-iron standard grade pipe, similar and equal to that manufactured by A. M. Byers Company, and provided with malleable iron or wrought-steel couplings. (See Paragraph 12-05 a(4)). Hand railing of wrought-iron pipe including sleeves for anchoring posts, where flanges are not used, shall be installed as indicated on the drawings, with any necessary bends in the pipe rails formed near the posts; the number of pinned joints shall be kept to the minimum necessary.

b. Payment will be made as specified in Paragraph 12-09 b.

12-07. Furnishing and installing miscellaneous black steel pipe (Item 38). a. - Settlement gages, grouting pipes, weepers, and bridge railing, shall be furnished and installed. The bridge railing shall be painted with one priming coat of red lead and two finish coats of paint as approved by the contracting officer.

b. Payment will be made as specified in Paragraph 12-09 b.

12-08. Furnishing and installing miscellaneous brass and bronze (Item 39). - a. The header to the leader pipe of the gage well shall be furnished and installed.

b. Miscellaneous brass and bronze shall not include electric wiring fixtures on builders' hardware included under other items of the work. Unless otherwise permitted, all bronze shall be approximately 88 parts copper, 10 parts tin and 2 parts zinc. Brass fittings, valves and other brass articles shall be of approved well known standard makes; brass or copper pipes shall be seamless drawn annealed pipes of standard size and thickness. No patching or plugging of bronze castings nor any cold working of brass or bronze will be permitted.

c. Payment will be made as specified in Paragraph 12-09 b.

12-09. Furnishing and installing copper water stops (Item 40). - a. Copper water stops required for the construction joints and expansion joints of concrete work shall be furnished and installed. Copper water stops used in concrete expansion and construction joints shall be continuous, and shall be crimped for expansion joints only. Splicing of the water stops shall be done by overlapping, riveting, soldering or brazing. Unless otherwise specified on the drawings the material shall be 20-ounce sheet copper of approved standard. At expansion joints the crimp shall be filled with a mastic filler of "elastite" or equal as manufactured by Philip Carey Co., Cincinnati, Ohio. Copper water stops shall be placed in the expansion joints indicated on the drawings

b. Measurement and payment. - (1) The quantities to be paid for under Items 35 to 40, inclusive, will be the number of pounds respectively furnished and installed in accordance with the drawings and specifications. Wherever practicable, the quantities shall be determined by weighing the articles and materials on the most accurate scales available. When weighing is not practicable, the weight will be determined by the contracting officer, who will use for that purpose scale weights, railroad shipping weights, manufacturers' weights, catalog weights, or computed weights. The weight of all tare, packing, and blocking will be deducted, using only net weights for payment quantities; provided, that no payment will be made for any weight in excess of 5 percent more than the computed weight as determined from the drawings.

(2) In calculating computed weights the following unit weights of the several materials will be used unless otherwise specified:

Structural Steel	-	0.2833 pounds per cubic inch.
Cast Iron	-	0.2604 " " " "
Brass and Bronze	-	0.310 " " " "

Wrought Iron Pipe - The weight per linear foot shown in Table I of Federal Specification WW-P-403.

Black Steel Pipe - The weight per linear foot shown in Table I of Federal Specification WW-P-403.

Copper Water Stops - 20-ounces per square foot.

SECTION XIII. ELECTRIC LIGHTING AND POWER SYSTEM (Item 41).

13-01. Work included. - The contractor shall furnish and install complete and ready for operation, all equipment and wiring for the lighting and power system of the operating house as indicated on the drawings and as required by these specifications. The contractor shall make all necessary connections to the traveling crane, the gasoline-electric standby unit, and gate hoists and shall furnish and install all wiring, conduits, outlets, fixtures, floodlight projectors, switchboard, lighting panelboard, fittings, and junction boxes.

13-02. General description. - a. The complete power system includes conduits, wires, switchboard, and all wire connections of external circuits to the several parts of the operating equipment.

b. The lighting system includes lighting transformer, fixtures, lighting panelboard, receptacles, floodlight projectors, conduits, wires, and the connection of the lighting transformer at the switchboard.

c. The battery-charging system includes conduit, wire, and battery charger with controls and meter for charging the battery on the gasoline-electric standby unit.

d. The incoming power line from the outside power source to a pull box in the basement of the operating house will be installed by other agencies and this work will not be included in this contract.

e. The electrical equipment will be subject to a wide range of atmospheric temperatures and moisture conditions and shall be suitable for such conditions.

13-03. Standard rules and specifications. - a. Unless otherwise specified, all electrical materials, workmanship, and tests shall conform with the current standard rules, regulations and specifications of the following authorities:

(1) American Institute of Electrical Engineers, 33 West 39th Street, New York, N. Y.

(2) National Board of Fire Underwriters, National Electrical Code, 85 John Street, New York, N. Y.

(3) National Electrical Manufacturers Association, 155 East 44th Street, New York, N. Y.

(4) Bureau of Standards, National Electrical Safety Code, Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

(5) Insulated Power Cable Engineers Association, 420

Lexington Avenue, New York, N. Y.

(6) Federal Specifications cited herein (Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.)

b. Copies of these rules, regulations, and specifications may be procured at the addresses as given, or may be seen at the U. S. Engineer Office, Providence, Rhode Island.

13-04. Conduits. - a. Conduits shall be located as indicated on the drawings or as directed by the contracting officer. Conduits with all necessary fittings will be required as follows:

(1) For operating-room lights, basement lights, front entrance lights, floodlights, and convenience outlets.

(2) For power and control wiring from the gasoline-electric generator unit to the switchboard.

(3) From the switchboard to each service gate hoist motor.

(4) From the switchboard to an outlet near the crane conductors for the crane-motor feeder.

(5) From the switchboard to a point six inches beyond the operating house for the incoming feeder from the outside power source.

(6) From a point on the inside of the wall of the operating room to a point six inches beyond the operating house for the telephone line.

(7) From the switchboard to the operating panel of the gasoline engine for the battery-charging feeder.

b. The conduits shall be hot-dip galvanized or sherardized on both inside and outside, and shall meet the requirements of Federal Specifications WW-C-581a for "Conduit, Steel, Rigid, Zinc-coated." Conduit fittings or bodies shall be galvanized, sherardized, or cadmium-plated high-test alloy castings of the types and sizes specified or shown on the drawings, or required for the work to be done. They shall be approved by the National Board of Fire Underwriters, and be similar and equal to those manufactured by the Crouse-Hinds Company. Conduit sizes shall meet the requirements of Article 346 of the 1937 edition of the National Electrical Code with the exception that no conduits smaller than 3/4-inch shall be used.

c. The installation of conduits shall comply with Article 346 of the 1937 edition of the National Electrical Code. All wires and cables shall be run in rigid conduits forming a complete raceway from the cabinet or panel to the last outlet in the system. Conduits shall be

run concealed in the walls or floors or run exposed as indicated on the drawings. Conduits in masonry walls and floors shall be built-in complete with all necessary fittings at the time the masonry is being placed. Any exposed conduits shall be securely fastened and anchored to the structural portions of the building and shall be run parallel with or at right angles to the walls. All conduits shall be run with long-radius bends where possible, and not more than four quarter bends shall be used on any run. All bends shall have a minimum radius of six diameters. If more than four bends are required, pull boxes shall be installed at points approved by the contracting officer. All conduit ends shall be reamed to remove burrs and obstructions after the threads have been cut. All conduit joints shall be made watertight with an approved sealing compound. At all conduit terminals there shall be provided approved bushings or conduit fittings. All metal conduit runs shall have electrical continuity. Open conduit ends shall be capped in an approved manner to exclude dirt and moisture. No threadless fittings or running-thread couplings shall be used on runs of conduit. As soon as possible after the concrete has set, each conduit shall be cleaned, inspected, and tested by the contractor to ascertain its mechanical and electrical continuity, and freedom from obstructions. Any defects in material or workmanship shall be remedied immediately as directed by the contracting officer. After each duct line is completed, the contractor shall inspect and test conduit in an approved manner and the conduit ends shall be capped.

d. The pull box for the incoming feeder from the outside power source shall be of cast iron, galvanized throughout and shall be similar and equal to the standard product of the Thomas & Betts Company, Inc., Elizabeth, N. J.

13-05. Wiring. - a. The contractor shall furnish and install all wire and cable, terminals, junction boxes, supports, hangers, make all connections, grounds, and properly place, arrange, and identify all material as specified or directed by the contracting officer. The contractor shall furnish, install, and properly connect to the switchboard a three-conductor, lead-covered cable for the incoming feeder. It shall terminate in the cast-iron pull box in the basement for the incoming feeder and the end shall be properly sealed. All wiring shall be in rigid conduit unless otherwise specified, shown on the drawings or directed by the contracting officer.

b. All wire used shall be copper, soft drawn and annealed, and having not less than 95 percent conductivity. Wire sizes shall comply with Article 300 of the National Electrical Code. No wire shall be used that is smaller than No. 12 A.W.G. except fixture wiring which shall not be smaller than No. 18 A.W.G. All wires and cables shall have flame-retarding and moisture-proof insulation and shall conform to Federal Specification J-C-106 for "Cable and Wire: Rubber Insulated Building Type, Superaging Grade (0 to 5,000-Volt Service)." All power wiring and outside lighting circuits shall be rubber insulated, multiple conductor with standard stranding and shall be totally enclosed with a pure lead alloy sheath.

c. All wire and cable shall be shipped on reels or in coils, plainly marked for complete identification, including the wire or cable size, number of conductors, length, weight, thickness, and character of the insulation, and the name of the manufacturer.

d. Materials used in the wiring shall conform to the following requirements:

(1) Solder for splicing or wiping shall conform to Federal Specification QQ-S-571, for "Solder Tin Lead", Grade A for sweat conductor joints.

(2) Solder for brazing shall conform to Federal Specification QQ-S-551, for "Solder, Brazing" Composition B.

(3) Silver Solder shall conform to Federal Specification QQ-S-561b for "Solder Silver", Grade 0.

(4) Rubber tape shall conform to Federal Specification HH-T-111 for "Tape, Rubber Insulating."

(5) Friction tape shall conform to Federal Specification HH-T-101 for "Tape, Friction", Grade A.

(6) Cotton tape shall conform to United States Navy Department Specification 17-T-15 for "Tape, Insulating, Linen Finish, Plain", thickness .007 inch.

13-06. Grounding. - Permanent and effective ground connections shall be provided for all metal cabinets inclosing electrical equipment, for equipment frames and housings, continuous runs of metal conduit, and elsewhere to comply with Article 250 of the National Electrical Code, and as specified or directed by the contracting officer. The contact area of all joints in grounding circuits shall provide a current carrying capacity not less than that of the connecting wire or cable, and the joints shall be bolted, soldered, or brazed, as specified or as directed. All ground connections to equipment that may require removal for maintenance or repair shall be bolted to the equipment.

13-07. Lighting and outlets. - a. The lighting panelboard, fixtures, floodlight projectors, receptacles, and outlet boxes shall be installed as specified and at locations indicated on the drawings and shall be in accord with the description as shown on the Bill of Material.

b. Lamps, except for floodlights, shall be rated at 115 volts and of the watt rating shown or specified and shall conform to Federal Specifications W-L-101d for "Lamps, Electric, Incandescent, Large, Tungsten-Filament."

c. All lighting fixtures shall be installed as specified and at locations indicated on the drawings and shall be similar and equal

to that specified in the Bill of Material. The operating house superstructure overhead fixtures shall be supported from the outlet boxes located on the bottom flange alongside of the web of the crane rail girder. The outlet boxes shall be supported either by clamping to the flange of the crane rail girder or by drilling the web of the girder. The flange of the crane-rail girder shall not be drilled.

d. The floodlights shall be located on the parapet as shown on the drawings and each shall be properly focused and oriented so that the intake and outlet works and the top of the dam shall be well lighted. The bulbs for the intake and outlet works floodlights shall be 500-watt, 230-volt, PS-40 lamps and the access road floodlight shall have a 1000-watt, 230-volt, PS-52 lamp.

e. The lighting panelboard shall be in accordance with Federal Specification W-P-131 and shall be of the surface type.

f. All sockets, switches, and receptacles shall be National Electrical Code Standard and shall be in accord with the description as shown on the Bill of Material.

13-08. Switchboard. - a. The contractor shall furnish and install at the location indicated on the plans, a two-panel, free-standing, safety, steel-enclosed dead-front type switchboard with removal cover plates in the rear. This switchboard shall provide electric power control for the entire operating house.

b. Facing the front of the switchboard, the panels, left to right, shall be arranged side by side in the order named below. Each panel shall control the circuits listed.

(1) Panel No. 1.

Combined generator, exciter, and regulator panel for gasoline-electric standby generating unit. Capacity 25 K.W. at 80 percent power factor, 31.3 K.V.A., 240 volts, three-phase, 60-cycle, A.C., with 125-volt D.C. direct-connected exciter.

Incoming feeder from outside power source.

Incoming feeder from the electric generator.

Battery-charging feeder for the gasoline-engine battery.

(2) Panel No. 2.

Four feeders for gate hoist motors, 230 volts, three-phase, 60-cycle, A.C.

One feeder for crane motor, 230 volts, three-phase, 60-cycle, A.C.

One feeder for lighting transformer 230 volts, single-phase, 60-cycle, A.C.

One feeder for lighting panelboard, 115 volts, single-phase, 60-cycle, A.C.

One feeder for battery charger, 230 volts, single-phase, 60-cycle, A.C.

One feeder for 1000-watt floodlights, 230 volts, single-phase, 60-cycle, A.C.

One feeder for the four 500-watt floodlights, 230 volts, single-phase, 60-cycle, A.C.

c. The panels shall contain the following equipment:

(1) Panel No. 1.

One voltage regulator.

One mounting for rheostat for exciter field (furnished under Item 45, see Section XVI).

One voltmeter, 0-300 volts, with selector switch for reading voltages, and with fuse cutouts and fuses.

One selector switch for connecting voltmeter to either the generator feeder or incoming line feeder.

One wattmeter, 0-40 kilowatts.

One field ammeter, 0-15 amperes, D.C.

One 100-ampere, three-pole air circuit breaker with three instantaneous and inverse-time-delay overcurrent trips and magnetic lockout attachment for 31.3 K.V.A. generator.

One 100-ampere, three-pole air circuit breaker with three instantaneous and inverse-time-delay overcurrent trips and magnetic lockout attachment for incoming power feeder from outside power source.

One 20-ampere, two-pole air circuit breaker provided with suitable thermal overload trip for the D.C. output of the battery charger.

One battery-charging rectifier (mounted inside of switchboard) with control adjustment operated from the front of the switchboard.

One ammeter, 0-100 amperes with necessary current

transformers and selector switch for reading the line currents.

One ammeter, 0-15 amperes, D.C. for battery-charging circuit.

(2) Panel No. 2.

Four 35-ampere, three-pole circuit breakers with suitable thermal overload and instantaneous short-circuit trips for gate-hoist motors.

One 25-ampere, three-pole circuit breaker with suitable thermal overload and instantaneous short-circuit trips for the crane motor.

One 35-ampere, two-pole circuit-breaker with suitable thermal overload and short-circuit trips for lighting transformer feeder.

One 50-ampere, single-pole circuit breaker with suitable thermal overload trip for lighting panelboard feeder.

One 15-ampere, two-pole circuit breaker with suitable thermal overload and short-circuit trips for battery-charging rectifier input.

One 15-ampere, two-pole circuit breaker with suitable thermal overload and short-circuit trips for the 1000-watt floodlight.

One 25-ampere, two-pole circuit breaker with suitable thermal overload and short-circuit trips for the four 500-watt floodlights.

(3) All incidental equipment necessary to complete the switchboard ready for operation.

13-09. Construction of switchboard. - a. Panels. - The switchboard shall be of the dead-front type of construction conforming to the standards of the N.E.M.A. All panels shall be of 1/8-inch "Stretcher-leveled" steel with a 1/4-inch radius bevel on all front edges and of equal width. The width of the panels shall be such as to give a compact and neat arrangement of the equipment without sacrificing efficiency and accessibility in the operation and maintenance of the switchboard. The panels shall be bolted to the switchboard frame and each shall be subdivided into vertical sections which may be removed to give access to apparatus on the subpanel. Slots shall be provided to accommodate the handles of switches and breakers. There also shall be provided on the front of the panel a visual indicator of the mechanical type to show the position of each switch or breaker. No unsightly gaps or wide joints shall be visible in the completed assembly.

b. Rear cover plates. - The rear of the switchboard shall be enclosed by cover plates which shall run the full height of the switchboard and shall be arranged in convenient widths. One panel shall be in the form of a swinging door with lock and concealed hinges. The cover plates shall fit snugly and no gaps or wide joints shall be visible in the completed assembly.

c. Busses and wiring. - All power conductors shall be of the proper cross section for the currents to be carried and no wire shall be smaller than No. 8 A.W.G. All control wire on the panels shall be run in wiring gutters provided on the side of the panels and shall be brought out to terminal blocks when it leaves the panels. All busses shall be mechanically rigid and designed to carry the rated current of the circuit with a maximum rise of 30 degrees C.

d. Finish. - All steel work shall be Bonderized or given similar treatment and given a dull black marine finish.

e. Name plates. - Suitable name plates shall be furnished for all circuits and controls. Name plates shall be black bakelite with engraved letters.

f. A rubber insulating mat shall be furnished and placed in the front of the switchboard. It shall extend the full length of the switchboard, and shall be 36 inches wide.

13-10. Switchboard equipment. - a. Lighting transformer. - The contractor shall furnish and install inside the switchboard enclosure a 5 K.V.A. transformer having a single-phase, 230-volt primary and a single-phase, two-wire, 115-volt secondary. The transformer shall be of the air-cooled dry type similar and equal to the General Electric Company type M.

b. All circuit breakers shall be of the air-break type, manually operated and trip-free. Circuit breakers for the feeders from the stand-by generator and the outside power source shall be three-pole, single-throw, stationary mounting, trip-free, and have a rating of 600 volts, 60 cycles, A.C., with an interrupting capacity of 10,000 amperes. The circuit breakers for the generator feeder and the feeder from the outside power source shall be provided with three instantaneous and three time-delay magnetic overcurrent trips and a magnetic lockout attachment on each circuit breaker. The magnetic lockout attachments on each shall be interconnected by means of auxiliary switches provided on the circuit breakers so that only one circuit breaker can be in the closed position at any time. These circuit breakers shall be similar and equal to the Type A E - 1 A manufactured by the General Electric Company.

c. Air circuit breakers for feeder protection of motors and equipment feeding from the main bus shall be provided with thermal overload and instantaneous magnetic short circuit trips and shall be rated at 600 volts, 60 cycles, A.C. Circuit breakers for feeder pro-

tection of the output of the lighting transformer and the battery charger shall be provided with thermal overload trip and shall be rated at 230 volts, 60 cycles, A.C. These circuit breakers shall be similar or equal to Type AB as manufactured by the Westinghouse Electric & Manufacturing Company.

d. Instrument switches for reading line voltages and currents shall be the rotary type and similar and equal to the General Electric Company type SB-1.

e. The voltage regulator shall be designed for automatic voltage control of the generator and arranged for operation in the exciter shunt-field circuit. It shall provide good regulation up to 150 percent of rated generator capacity and shall be similar and equal to General Electric Company's type GDA.

f. A battery charger of approved make, similar, and equal to the product of the General Electric Company shall be installed inside the switchboard. It shall operate from a 230-volt, 60-cycle, A.C. feeder and be capable of charging a 12-volt battery at the rate of 12 amperes. It shall be provided with an adjustment for varying the charging rate from zero to maximum in at least 12 steps and an ammeter to indicate the direct current output, both of which shall be mounted on the front of the switchboard.

g. All fuses shall comply with Federal Specification W-F-791 for "Fuses, Cartridge, Inclosed, Non-renewable."

h. Meters shall be rectangular, semi-flush mounted, have a 5-inch scale and shall be similar and equal to the corresponding product of the General Electric Company.

13-11. Payment. - The contractor will be paid the lump sum contract price for Item 41 for furnishing, installing, testing, and placing in operation for lighting and power system as required by the specifications and shown on the drawings.

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SECTION XIV. INSTALLING EQUIPMENT FURNISHED BY THE GOVERNMENT (Items 42 and 43).

14-01. Work included. - The following equipment will be furnished by the Government and shall be assembled and installed by the contractor.

a. Four service gates, complete with frames, guides, motor-operated screw hoists and accessories (Item 42).

b. One emergency gate, complete with four sets of frames, guides and accessories (Item 42).

c. Four sets of conduit linings (Item 43).

14-02. Delivery. - The equipment to be furnished by the Government will not be available prior to 180 days after notice to proceed. All of the equipment will be available thereafter and the contractor shall give the contracting officer 30 days written notice of the desired date of delivery (see Paragraph 1-14).

14-03. Workmanship of installation. - The contractor shall install, erect, attach or build into the structures all the machinery, piping, and other metal work in a workmanlike manner as specified or directed by the contracting officer. All work of the installation of the equipment shall follow the best modern practice in the installation of machinery of this type, notwithstanding any omission from these specifications, and shall be performed under the supervision of a representative of the manufacturer. All work shall be done by mechanics skilled in their various trades.

14-04. Installing equipment (Items 42 and 43). - a. Installation. - (1) The gates, gate hoists, and accessories shall be assembled and installed complete as indicated on the drawings, under the supervision of a representative of the gate manufacturer, and as directed by the contracting officer.

(2) The contractor shall furnish and place concrete for loading the emergency gate as directed. The concrete loading shall contain coarse aggregate having a sufficient weight of steel slugs, or as otherwise directed by the contracting officer, that will furnish concrete which shall weigh approximately 250 pounds per cubic foot.

(3) The frames of all gates, and all sections of the conduit linings shall be assembled in place and bolted together. All gates shall be placed in the assembled frames and securely bolted to them, and spacer rods shall be placed in the second emergency gate frame. The assembled units shall then be checked for alignment and elevation, and the two sets of structures shall be substantially anchored in place. After the form work is completed at the ends of the conduit linings

the concrete shall be carefully placed around the frames and conduit linings bringing the top of the concrete to the elevation specified. Spacer rods and bolts of the proper size to be used in the second emergency gate frame to maintain correct clearances and all bolts, special tools, jacks, and other devices necessary to erect the gates and linings, and any special anchors required to secure the assembled parts while they are being concreted in place, shall be furnished with the gates. The gate guides shall be assembled as the concrete is carried up in the gate shaft. The sections shall be properly riveted together and carefully aligned with the gate frames and each other so that the working surface shall be a plane surface, smooth and free from irregularities throughout its length.

(4) The motor-operated gate hoists shall be installed in correct alignment with the service gates. The hoists will be self-contained, electric motor-driven units. Connection of the main feed wires only will be required for the electrical installation of the hoist. A limit switch to cut off the motor at each end of the gate travel will be provided on the hoists; this limit switch shall be accurately set at the time of installation. A gate position indicator will be provided on the hoists and they shall be accurately adjusted at the time of installation.

b. After completion of the operating house structure and the installation of all machinery, each gate shall be tested for satisfactory operation by being raised and lowered several times for its full length of travel. Any adjustments in the setting or installation required to secure satisfactory operation and tight closure of the gates shall be made by the contractor. The service gate and emergency gate hoists and motors shall be tested as directed and any adjustments or changes that may be required in the opinion of the contracting officer shall be done by the contractor.

14-05. Operation of equipment. - After installation, all of the equipment furnished by the Government and installed under the contract shall be placed in operation by the contractor and operated for a sufficient length of time and in such a manner as to satisfy the contracting officer that the equipment has been properly installed. In the event the operation of the equipment by the contractor discloses any defect due to faulty or improper installation, the equipment shall be immediately shut down and said defect shall be corrected by the contractor to the satisfaction of the contracting officer. All field tests of this equipment will be conducted by the Government.

14-06. Painting. - After installation of equipment the shop-painted equipment shall be touched up or given a second priming coat, or both, as found necessary by the contracting officer and shall be followed by finish painting (see Paragraph 17-04).

14-07. Measurement and payment. - a. Payment for installing the several items of equipment furnished by the Government will be made by

the pound at the applicable contract unit prices for Items 42 and 43, and shall include the cost of unloading and hauling from the point of delivery, storing, handling, erecting, placing, painting, testing, and maintaining said equipment until final acceptance of the work by the contracting officer. Payment will be made in one sum after the equipment has been installed, connected and tested to the satisfaction of the contracting officer.

b. The quantities to be paid for under Items 42 and 43 will be determined from actual scale weights or by computed weights, at the option of the contracting officer. In calculating computed weights the following weights of the several materials shall be used:

Structural steel	- 0.2833	pounds	per	cubic	inch
Cast iron	- 0.2604	"	"	"	"
Malleable iron	- 0.2833	"	"	"	"

Only the actual net weights of the equipment installed will be used in measurement for payment, and all tare, packing, and blocking will be deducted.

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SECTION XV. TRAVELING CRANE (Item 44).

15-01. Work included. - The contractor shall design, furnish and install one traveling crane complete, in the operating house, in accordance with the drawings and the specifications.

15-02. General description. - The crane shall be of 15-ton capacity and will be used for infrequent duty at slow hoisting speed. Clearance limitations are indicated on the drawings.

15-03. Detailed description. - a. Hoist. - (1) The gearing for the hoist shall be accurately machine cut and shall be of ample strength and fully inclosed with safety guards. The diameter of the hoist drum shall be not less than that recommended in Federal Specification RR-R-571. The drum shall be machine grooved to fit the rope. The required maximum lift for the hoist shall be as indicated on the drawings. Overlapping of the rope on the hoist drum will be permitted. The hoist shall be provided with two automatic safety brakes, one mechanical and one electrical. The mechanical brake shall be of sufficient capacity to prevent acceleration of the load when lowering by power and shall be able to stop the movement of the load and to maintain it in any position when the power is off. The brake shall be so designed that it will not over-heat within the time required to completely and continuously lower the hook at full load, the full length of travel. The hoist shall be provided with an automatic electric solenoid brake connected in the motor circuit in such a manner that the brake comes automatically into operation when the power is interrupted.

(2) The hoist shall be operated by a 220-volt, three-phase, sixty-cycle wound rotor induction motor designed for continuous duty 50 degrees C. temperature rise. The motor shall be controlled by means of a drum-type controller with resistors of the unbreakable type, operated by pendant ropes and a cable drum with positive spring return. The electrical equipment shall be protected by undervoltage and thermal overload relays. Overload relays shall be automatic reset. The hoisting speed shall be not less than 1 foot per minute, at which speed the normal motor horsepower shall not be exceeded. The hoist shall be protected by a suitable limit switch which will prevent over-hoisting. The make and type of motor and control equipment shall be subject to approval by the contracting officer.

(3) All bearings shall be of ample size and of a type best suited for the service intended. Bronze or babbitt bearings shall be provided with oil ring, wick or other means of lubrication satisfactory to the contracting officer. Anti-friction bearings shall be provided with grease retaining rings.

b. Hoist trolley. - The hoist trolley frame may be made from steel castings or structural steel. It shall be rigidly constructed and shall provide ample support for the hoist mechanism. The

construction must be such that the load will at all times be equally distributed to the two bridge girders and as near equal distribution as practicable on the four wheels of the trolley. Trolley wheels shall be doublt flanged, with turned tread, and shall be of a material suitable for the capacity of the crane. Wheel bearings shall be anti-friction bearings of ample capacity and of a design acceptable to the contracting officer. Travel of the trolley shall be by means of a pendant hand chain suitably geared to one wheel on each bridge girder. The gear ratio shall be suitable for one-man operation with full load on the crane. A locking device shall be provided to keep the trolley at any position on the bridge when lifting to capacity.

c. Hoist blocks. - Hoist blocks shall be of rugged construction. The diameter of the sheaves shall be not less than that recommended in Federal Specification RR-R-571. The sheaves shall be provided with bronze bushings with satisfactory means of lubrication. The hook shall be a steel forging of ample size for the use intended, and shall be provided with anti-friction swivel bearings.

d. Bridge. - The bridge shall consist of two girder beams of ample section to provide rigidity against excessive vertical deflection and side sway. The girders shall be securely attached and braced to the end trucks. The bridge shall be equipped with a squaring shaft operated by a pendant hand chain and suitable gearing.

e. End trucks. - The end trucks shall be of rigid construction and shall be provided with double flanged wheels of a material suitable for the crane capacity. The wheels shall have turned treads and shall be provided with anti-friction bearings of ample capacity. One wheel of each end truck shall be geared to the squaring shaft on the crane bridge.

f. Electric connections. - The crane shall be fully wired and provided with all necessary controls. In addition to the necessary wiring on the crane, the contractor shall furnish the collectors and all necessary conductors and supports for them. They shall be placed as shown on the drawings or above the crane so that in no case will it be possible for the hook or control cables to come in contact with them.

g. Hoist cable. - The hoist cable shall be a preformed extra pliable hoisting rope made of improved plow steel in compliance with Federal Specification RR-R-571, Type XXXIII and shall be thoroughly impregnated with a corrosion resistant lubricant satisfactory to the contracting officer.

h. Safety features. - The crane shall have incorporated in its design, all safety features necessary to protect the equipment and the crane operator. These safety features shall include rail sweeps, runway stops for both bridge and crane runway and limit switches.

15-04. Design. - a. The detailed design of the traveling crane

shall be such that all working parts shall be readily accessible for inspection and repair, easily duplicated and readily replaced with each and every part of the machinery properly designed and suitable for the uses and services required.

b. The design stress for any member or part of the material covered by these specifications shall not be greater than one-fifth of the ultimate strength of the material used.

c. Unless otherwise specified, bearings may be lined with babbitt or bronze. Where the bearing pressure is in excess of 200 pounds per square inch, the bearings shall be lined with bronze. Pressures on bronze-lined bearings shall not exceed 1000 pounds per square inch of projected area. Anti-friction bearings of approved types and of sizes not less than recommended by the bearing manufacturer for the duty, may be used at the option of the contractor. All bearings shall be properly aligned and provided with suitable means for lubrication. Anti-friction bearings shall be so installed as to provide for retention of lubricant and to exclude dirt and grit.

15-05. Drawings. - The contractor shall design the traveling crane in accordance with clearances indicated on the drawings and with these specifications. The contractor shall submit design computations and detail drawings for the traveling crane he proposed to install in sufficient detail to enable a check on the design. These drawings shall conform to the requirements of Paragraph 15-03 and shall include a complete and itemized list of all parts, with the grade and class of material or make of a standard article, the contractor proposes to furnish. The item number in the list of parts shall be shown on the drawing by means of a circle enclosing the item number and a solid light line connecting the circle to the part. Thickness of plates and sizes of structural shapes must be shown either on the part or in the itemized list of parts. Proposed construction shall be clearly shown on the drawings by the liberal use of sections, enlarged details and by other means. Any item or part omitted from the drawings or list of parts but needed to comply with the requirements of these specifications or any item or part omitted from the drawings or the list of parts and also omitted from the requirements of these specifications, but needed in order to provide a complete and workable installation in accordance with the intent of these specifications, shall be supplied by the contractor the same as if included on the drawings, the list of parts, or in the requirements of these specifications. Approved drawings submitted by the contractor shall become a part of these specifications.

15-06. Materials and workmanship. - a. The traveling crane shall be constructed of the grade and class of materials as indicated on the "List of Parts" on the design drawings as furnished by the contractor and approved by the contracting officer and shall conform to the specifications listed in Section XII, where applicable.

b. All metal workmanship shall be of standard quality and

all electrical materials, workmanship and tests shall be in conformity with the current standard rules, regulations and specifications of the American Institute of Electrical Engineers and the National Electrical Manufacturers Association.

c. The wiring shall conform to the National Electric Code in regard to size of wire installation, spacing and attachment to the crane.

15-07. Installation. - The traveling crane, as equipped, including conductor bars and supports, shall be assembled and installed in the operating house as indicated on the drawings.

15-08. Inspection and tests. - a. The traveling crane shall be completely assembled in the shop and tested as directed by the contracting officer. These tests shall include the complete operation of the crane throughout all its functions. The contractor will be required to correct to the satisfaction of the contracting officer, without expense to the Government, all defects found during these tests.

b. The traveling crane will be tested by the Government as soon as practicable after installation. The field tests will include complete operation of the crane throughout all its functions. Acceptance and final payments will not be made until such tests are completed to the satisfaction of the contracting officer.

c. The cost of all testing shall be borne by the contractor, except for the Government's representatives, and shall be included in the contract price for the item.

15-09. Painting. - Shop painting shall be in accordance with the provisions in Paragraph 17-04. Such retouching as may appear necessary in the opinion of the contracting officer, shall be done with the same shade of paint as the shop coat. All finished surfaces to be exposed to the atmosphere during shipment shall be coated with a heavy rust preventive compound. Field painting of all exterior parts, except brass, bronze or finished surfaces shall be done in accordance with the provisions of Section XVII.

15-10. Payment. - a. Payment for designing, furnishing and installing the traveling crane will be the lump sum contract price for Item 44, and includes all necessary accessories not included in any other item.

b. Partial payments will be made as follows: 50 percent of the contract price will be paid when the unit has been shop tested to the satisfaction of the contracting officer; an additional 25 percent of the contract price will be paid when the unit has been delivered at the site of the work; and the remaining 25 percent of the contract price will be paid after the field tests have been made to the satisfaction of the contracting officer.

SECTION XVI. GASOLINE-ELECTRIC STANDBY UNIT (Item 45).

16-01. Work included. - The contractor shall furnish and install in the operating house in the location shown on the drawings one complete and fully equipped gasoline-electric standby unit.

16-02. General description. - a. The unit shall consist of a self-contained gasoline engine, direct-connected through a flexible coupling to a revolving field, synchronous type, alternating-current generator with a direct-connected exciter. The generator shall be a three-phase, sixty-cycle, 240-volt, 1200 r.p.m. unit and shall have a rated output of 25 K.W. at 80 percent power factor.

b. The unit shall be equipped with a starting motor and storage battery for self-starting; control equipment including rheostat for exciter field, voltage regulator complete, and battery charging equipment, and all incidental ignition equipment, miscellaneous wrenches for special nuts and a suitable detachable handcrank for the gasoline engine, and complete operating equipment.

16-03. Gasoline engine. - a. General. - (1) The engine shall be of late design and a current model, standard with the manufacturer and shall be the product of a reliable manufacturer who can show at least five years' experience in the successful manufacture of engines for similar duty. The engine shall be a self-contained, four-cycle, industrial type, having not less than 4 cylinders, with a normal horsepower rating at 1200 r.p.m.

(2) Rating. - The maximum horsepower of the engine shall not be less than 15 percent greater than that required at the maximum output of the generator at 1200 r.p.m.

(3) Vibration. - The unit, complete with its generator and exciter, shall be free from objectionable torsional vibration from 60 r.p.m. below to 60 r.p.m. above normal governed speed.

b. Construction. - The principal parts of the engine assembly shall be as follows:

(1) The bed-plate shall be integral for engine and generator, it shall be provided with a drip edge and shall be of cast-iron or structural steel accurately machined for mounting the engine and generator.

(2) The crankcase shall be a cast-iron pedestal-base type, equipped with large removable side plates for easy inspection and adjustment of all working parts of the engine.

(3) The cylinders and cylinder head shall be of a special cylinder-iron having a tensile strength of not less than 35,000

pounds per square inch.

(4) The crankshaft shall be a one-piece chrome-nickel steel forging properly heat-treated. It shall be dynamically and statically balanced. All bearing surfaces shall be of sufficient area and accurately ground to conform to standard practice for such work.

(5) The camshaft shall be of forged alloy steel, heat-treated, and accurately ground on all journal bearings and cam profiles.

(6) The connecting rods shall be of high-grade forged alloy-steel, properly heat-treated.

(7) Pistons may be of light-weight cast-iron, or alloy. Each piston shall be equipped with at least four rings, three above the piston-pin and one below. The piston pin shall be of tubular hardened steel, accurately ground and securely locked in place.

(8) Push rods shall be of hardened steel and accurately ground. The push rod guides shall be bronze and of the removable type.

(9) The valves shall be of special steel, of large area, accurately fitted, and ground to fit the valve insert seats.

(10) The flywheel shall be of gray iron or steel, statically and dynamically balanced. It shall be securely attached to the crankshaft ahead of the flexible coupling.

(11) The flexible coupling shall be of the fibre disk type or approved equal. The coupling shall be provided with a safety guard.

(12) The exhaust manifold shall be a close-grained gray iron casting provided with suitable flange connections having a straight pipe thread for exhaust pipe and shall be fully water jacketed. The exhaust pipe shall be standard weight pipe of black wrought-iron, and that part above the operating floor shall be suitably covered with 85 percent asbestos pipe covering 1 inch thick. The exhaust muffler shall be of an approved type of non-corrodible material; it shall be located inside the building on the piping below the operating floor. Insulating sleeves shall be provided in the concrete floor and wall.

(13) The cooling system shall be designed to maintain engine temperature between 160 degrees F. and 180 degrees F. It shall hold the temperature high enough to maintain power and combustion efficiency, and low enough to prevent boiling. The radiator shall be of adequate capacity to cool the engine when it is operating continuously in ambient temperatures up to 100 degrees F., without the water boiling when ordinary water is used as a cooling medium. The core shall be of flat tube and fin construction and the upper and lower and side tanks shall be case. Thermostats suitably located between the radiator and

engine shall permit the water to circulate through the engine only until the temperature of the water increases sufficiently to open the thermostat and permit radiator circulation.

(14) The lubrication system shall be force feed to the main bearings, camshaft bearings, valve operating mechanism, and gear trains. The oil shall be supplied under pressure by a positive gear-driven pump. The pump shall be removable from the engine without the necessity of dismantling the engine.

(15) High-tension ignition systems, consisting of an approved magneto with impulse starter device, and in addition, a distributor using current from the starting battery shall be provided. The ignition shall be so controlled that either system of ignition may be employed by operating a switch.

(16) The fuel system shall include a mechanical fuel-pump and a hand-fuel-pump to furnish fuel to the carburetor from the gasoline tank located beneath the operating room floor.

(17) The governor shall be non-hunting, similar and equal to Type WO as manufactured by the Woodward Governor Company, and shall provide speed regulation within 5 percent of normal speed, when full load is suddenly thrown on or off. The speed variation from normal speed shall not vary more than 1 percent plus or minus at any continuous load.

(18) The gasoline tank shall have a capacity of at least 50 gallons and shall be constructed of copper or other rust-proof material. The tank shall be located directly beneath the operating room floor as near the engine as possible and supported by structural steel brackets on the wall. Provisions shall be made for filling the tank from the operating room floor. The contractor shall make all necessary connections from the gasoline tank to the fuel pump and carburetor system. A level gage of the dial type shall be furnished and installed on the engine instrument panel. The installation and design of the gasoline tank shall comply with the requirements of the National Board of Fire Underwriters. The drain connection shall be fitted with a pipe plug. Piping to the fuel pump on the engine shall leave the tank from the top.

(19) The following operating accessories shall be provided:

(a) One electric starting motor.

(b) One battery in case.

(c) One oil filter.

(d) One air filter and flame arrestor.

(e) One exhaust muffler and necessary piping to discharge exhaust gas down through the floor and thence to the outside of building (see drawings for location).

(f) One tachometer.

(g) One oil-pressure gage.

(h) One gasoline gage.

(i) One ignition switch with lock.

(j) One temperature gage.

(k) One crank.

(l) One instrument board for mounting the gasoline gage, oil gage, temperature gage, tachometer, ignition switch, and starting switch.

(m) One battery hydrometer for testing battery, and one set of necessary adjusting tools and wrenches complete for equipment furnished.

(n) One pressure temperature operated switch, so arranged that it will open the ignition circuit in the event that the oil pressure is inadequate for safe operation or cooling water temperature exceeds that at which the switch is set to operate.

16-04. Generator. - a. The alternating-current generator shall be of open construction suitable for mounting on the engine bed-plate; and of the type and capacity rating as indicated in Paragraph 16-02. It shall be capable of developing its full rating continuously with a temperature rise not to exceed 50 degrees C. above an ambient of 40 degrees C.; shall in all respects conform to the standards of the American Institute of Electrical Engineers and the National Electrical Manufacturers Association; and shall be the product of a reliable manufacturer who can show at least five years' experience in the successful manufacture of electrical equipment of this type.

b. The stator and rotor windings shall be insulated with Class "A" insulation as defined by the American Institute of Electrical Engineers, and shall be designed to resist moisture during long periods of idleness.

c. The exciter shall be mounted on an extension of the generator end bracket, and shall be direct-connected to the rotor of the generator. The exciter shall be shunt wound and of sufficient capacity to afford proper excitation to field coils at 150 percent of the generator rating. The terminal voltage shall be 125 volts D.C. The exciter shall be designed to operate with the voltage regulator as specified in

Paragraph 13-10e to provide good voltage regulation up to 150 percent of rated capacity of the generator.

d. The armature windings shall be star-connected and the neutral wire shall not be brought out but grounded internally to the frame of the generator. The armature terminals shall be located on the right-hand side of the generator, reference being at the exciter facing the drive, and they shall be housed in a drip-proof terminal box, with a removable cover, to which conduit may be readily connected from below.

e. The generator shall be equipped with bearings of ample size. The bearings shall be bronze or babbitt lined and shall be provided with positive self-lubrication by oil rings extending into an oil reservoir.

f. Slip rings shall be of bronze or brass. Brush holders shall be of rugged construction and shall be provided with an adjustable tension spring which can be adjusted while the machine is in operation and then locked in position. If the brush holder is of ferrous material it shall be Parkerized or otherwise treated to prevent rust.

g. All small parts and fittings shall be non-corrodible or shall be rust-proofed by a suitable process approved by the contracting officer.

16-05. Storage battery. - A 12-volt electric storage battery shall be provided, consisting of two 6-volt units. Each 6-volt unit shall have genuine hard rubber containers and wood and rubber separators, shall have positive plate separators not less than 0.161 inch in thickness, shall have a capacity of not less than 200 ampere-hours at a 20-minute discharge rate and shall be capable of discharging at 300 amperes for not less than 7.5 minutes at zero degree F. without falling below 4.7 volts.

16-06. Control equipment. - A rheostat shall be furnished for the exciter field suitable for mounting on the back of the switchboard with the controls extending through to the front as designated in Paragraph 13-08.

16-07. Design and drawings. - a. The detailed design of the standby unit shall be such that all working parts shall be readily accessible for inspection and repair, easily duplicated, and readily replaced with each and every part of the equipment of the machine properly designed and suitable for the uses and service required.

b. Before purchasing the gasoline-electric standby unit, the contractor shall furnish drawings and specifications for the proposed standby unit for approval. The drawings shall include the engine, generator, exciter, and all accessories, with dimensions of concrete base for mounting. Accessories shall be listed on the drawings by catalog number with name of manufacturer; and shall be accompanied by cuts and

the manufacturer's specification for the accessories, all properly numbered to agree with the list as shown on the drawings.

16-08. Installation. - All work shall be done neatly and accurately and shall be in accordance with the highest standards of practice for equipment of the type to be furnished. The engine and generator shall be accurately aligned on the bed-plate and securely attached thereto. Provision shall be made for lifting the engine and generator, both sepatately, and the entire unit completely by a crane. The unit shall be erected accurately to line and level, including the concrete base required therefor; thoroughly secured; and every detail of the work of installation shall be done in a thoroughly workmanlike manner.

16-09. Inspection and tests. - a. The standby unit shall be inspected and tested in the shop in the presence of an authorized representative of the contracting officer, unless written notice is given by the contracting officer waiving this right. In that case, the tests shall be made and a typewritten record of them, including observations, calculations, results, and graphs shall be submitted to the contracting officer together with a sworn statement from the manufacturer or person supervising the tests. The unit shall be tested for satisfactory operation under the following conditions:

(1) The engine shall be run at rated speed (1200 r.p.m.) for two (2) hours at twenty-five percent (25%) overload of generator rating, on dynamometer test.

(2) The combined unit shall be run continuously for eight (8) hours at full load, and shall show no evidence of serious vibration.

(3) The valve setting and governor control shall be checked by means of a tachograph, with the entire unit operating under various loading conditions ranging from no-load to 25 percent overload of the generator rating (see Paragraph 16-02).

(4) All tests shall be made using commercial standard gasoline, not special or high test fuels.

(5) All required tests to determine that the generator, exciter, and electrical accessories conform with these specifications, and with the standards of the American Institute of Electrical Engineers and National Electrical Manufacturers' Association, shall be made before shop acceptance.

(6) Immediately after running tests for the engine the contracting officer or his representative may require that the engine be opened for inspection. Typewritten records of all the above tests, including all observations, calculations, results, and graphs shall be certified and submitted by the contractor to the contracting officer as soon as practicable after completion of the tests.

b. Field tests and trials shall be made after installation under the supervision of and as directed by the contracting officer. They shall be of sufficient loading and duration to demonstrate to the satisfaction of the contracting officer that the complete unit as installed is in conformity with the specifications.

c. The cost of all testing shall be borne by the contractor, except for the Government's representatives, and shall be included in the contractor's bid price for the item.

16-10. Painting. - Shop painting shall be in accordance with the provisions in Paragraph 17-04. Such retouching as may appear necessary in the opinion of the contracting officer, shall be done with the same shade of paint as the shop coat. All finished surfaces to be exposed to the atmosphere during shipment shall be coated with a heavy rust preventive compound. Field painting of all exterior parts, except brass, bronze or finished surfaces shall be done in accordance with the provisions in Paragraph 17-04.

16-11. Payment. - a. Payment for furnishing and installing the gasoline-electric standby unit shall be the contract price for Item 45 and includes all costs of furnishing the concrete base therefor.

b. Partial payment up to 50 percent of the contract price will be made when the equipment is delivered to the site of the work, provided the quality of such equipment is satisfactory to the contracting officer, but in no case will the initial payment to the contractor exceed the cost of the equipment delivered to the site of the work. The equipment shall be stored and kept protected from deterioration in a manner satisfactory to the contracting officer. If any equipment so stored and partly paid for is not kept protected, no further partial payments will be made and the equipment will be protected by the contracting officer at the expense of the contractor. The balance will be paid after the installation and completion of the field tests to the satisfaction of the contracting officer.

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SECTION XVII. PAINTING.

17-01. Work included. - The contractor shall do all shop painting of equipment furnished by him and field painting of all equipment, as required by these specifications and necessary properly to protect and finish the work in a thorough and workmanlike manner. This shall include shop painting of all unfinished iron and steel parts of members, except iron and steel that is to be encased in concrete; field painting of all such iron and steel work; and finish painting of all doors.

17-02. Paint materials. - All paint used shall conform, where applicable, to Federal Specifications of Group TT. Shop and field priming coats shall be a pure red-lead paint mixed in approximately the following proportions:

Paste red lead	100 lbs.
Raw linseed oil	1-7/8 gals.
Turpentine	2-1/2 pints (max.)
Drier	2-1/2 pints (max.)

Paint for finish coats on the machinery and piping shall be a pure lead, zinc, and linseed oil paint of a composition and color approved by the contracting officer. Samples of all paint shall be submitted to the contracting officer for approval and selection.

17-03. Painting structural steel. - a. All structural steel work not to be encased in concrete shall be given one shop coat and one field coat of red lead paint. After the shop work has been completed and accepted, all material shall be cleaned of rust, loose scale, dirt, oil, grease, and other foreign substances. Oil and grease shall be removed by wiping with gasoline or benzene. After it has been cleaned, the steel shall be given one shop coat of red lead paint. Surfaces which will not be accessible after assembly, but not in contact in riveted connections, shall be given a second shop coat.

b. After erection the structural steel shall be touched up by painting over all spots where the shop coat has been scratched, knocked off, or otherwise damaged. After touching up, the steel shall then be given a field coat of red-lead paint. Either the shop coat or field coat shall contain a small amount of lamp black so that the field coat may be readily differentiated from the shop coat. The finish painting of exposed interior structural steel shall match the finish color of machinery and shall conform to the provisions of Paragraph 17-02 for finish painting of machinery and other details.

17-04. Painting equipment. - As hereinbefore provided, all unfinished iron or steel parts of the machinery and equipment shall be given one shop coat of paint. Shop painting shall be done in accordance with the manufacturer's standard practice and shall be subject to the approval of the contracting officer. After installation, the shop-

uncontrolled flows are not cleansing action. However, the existing

painted surfaces shall be touched up or given a second priming coat, or both, as found necessary by the contracting officer. These surfaces shall then be given two finish coats of the paint selected by the contracting officer.

17-05. Painting pipe. - Iron and steel pipe, valves, and fittings shall be given one shop priming coat in accordance with the standard practice of the manufacturer. After installation, they shall be given one coat of red lead paint and two finish coats of the paint selected by the contracting officer.

17-06. Application of paint. - Paint shall be applied by brushing or spraying, provided satisfactory results are obtained. No paint shall be applied on damp or frosted surfaces and material painted under cover in damp or cold weather shall remain under cover until dry. Painting shall be done in a neat and workmanlike manner, and all joints and crevices shall be thoroughly coated.

17-07. Payment. - No direct payment will be made to the contractor for painting, but all compensation desired therefor shall be included in the prices bid for the various contract items involved.

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SECTION XVIII. MISCELLANEOUS (Items 46 to 50 incl.)

18-01. Highway cable fencing - complete (Item 46). - a. Work included. - The contractor shall furnish and construct, as shown on the drawings or ordered, cable guard rail on the edges of the roadways and at such other places as directed, conforming to the standard of Massachusetts Department of Public Works for the type of construction specified.

b. Materials. - (1) Posts shall be constructed of Class "A" reinforced concrete to the sizes and dimensions as shown on the drawings. The maximum size of coarse aggregates shall not exceed one inch in size. The reinforcement shall conform to the requirements of Paragraphs 9-18 and 12-02.

(2) The wire rope shall be 3/4-inch diameter, conforming to the requirements of Federal Specification RR-R-571 and subsequent amendments thereof, Type III, 6 by 7-wire rope, annealed steel, galvanized.

(3) All fittings for highway guard rail, except anchor rods, nuts and washers, shall be of galvanized drop forgings, conforming to Class "B" of A. S. T. M. Designation A18-30. Nuts and washers shall conform to Paragraph 12-02. The cables shall be fastened to the concrete posts with offset fittings and to the anchor blocks as shown on the drawings. The fasteners on the end posts and on the posts where intermediate anchorages are made, shall be steel provided with a bearing bracket. Each cable shall be attached to its respective socket by hot zinc socketing conforming to Federal Specification RR-R-571, Paragraph 1-12.

c. Construction methods. - The posts for the highway cable guard rail shall be spaced and securely set and the cable strung as shown on the drawings or as directed by the contracting officer. Backfilling shall be thoroughly tamped into place. Each anchor and end post shall have a footing of concrete or a single stone at least 12 inches square and four inches thick as shown on the drawings. The cable shall be drawn taut and anchored by a precast concrete anchor block or other anchorage approved by the contracting officer. Dummy posts, other than those at the ends of cable guard rails, shall be placed to mark culverts or elsewhere as ordered. After erection all exposed surfaces of the posts shall receive a uniform application of a solution consisting of 8 pounds of zinc sulphate to one gallon of water. This application shall be allowed to set for at least 48 hours after which the posts shall be brushed thoroughly to remove any surface crystals of zinc sulphate. The posts, when perfectly dry, shall receive two coats each of white paint and black paint as directed. The black paint shall extend from the ground up to the bottom cable. The posts shall be thoroughly dried out and aged before the application of any paint materials.

d. Measurement and payment. - The quantity to be paid for at the contract unit price for Item 46 will be the number of linear feet of cable guard rail satisfactorily completed in accordance with the requirements of Paragraph 18-01 b and c. The contract unit price shall include all materials, equipment, tools, labor and work incidental thereto; also all excavations for posts, backfilling and disposal of surplus materials. The measurement will be made from outer post to outer post to which cable is attached, with an additional allowance of 20 feet to cover the cost of anchoring at each anchor block, and to cover the cost of dummy posts to be set at anchor blocks at ends and with an additional allowance of 5 feet for each dummy post set, other than those at the ends of the cable guard rail.

18-02. Highway chain link fence - complete (Item 47). - a. Work included. - The contractor shall furnish and install a chain link fence supported by concrete posts, along the edges of the top of the dam, and in other locations, as shown on the drawings or as directed by the contracting officer.

b. Material. - (1) The posts shall be constructed of Class "A" concrete conforming to the requirements of Section IX. The maximum size of coarse aggregate shall not exceed one inch. The size and dimensions of posts shall be as shown on the drawings. The reinforcement shall conform to the requirements of Paragraph 9-18.

(2) The fencing shall be 2-inch diamond mesh #8 gauge galvanized steel, 3 feet high, and shall conform to the requirements of Federal Specification RR-F-191 "Fencing - Chain Link or Welded", Type A, Class 1.

(3) The chain link fencing shall be attached to the concrete posts by vertical, galvanized wrought iron straps, or other approved shapes, and secured by galvanized wrought iron bolts cast in the concrete posts.

(4) All fittings shall be heavy galvanized wrought-iron and shall conform to the requirements of Paragraph 12-02.

c. Construction methods. - The concrete posts for the chain link fence shall be spaced and securely set, backfilling thoroughly tamped into place, and the posts painted (see Paragraph 18-01 c), as shown on the drawings or as directed. The end posts as shown on the drawings, shall be set in Class "A" concrete conforming to the requirements of Section IX. The chain link fencing shall be placed, drawn taut and secured and otherwise completed as shown on the drawings or as directed.

d. Measurement and payment. - The quantity to be paid for at the contract unit price for Item 47 will be the number of linear feet of chain link fence with concrete posts satisfactorily

completed in accordance with the requirements of Paragraph 18-02 b and c. The contract unit price shall include all materials, equipment, tools, labor and work incidental thereto; also all excavations for posts, backfilling, disposal of surplus materials, and painting. Measurement for payment will be made from outer post to outer post to which the chain link fencing is attached.

18-03. Bituminous macadam road surface. - (Items 48A and 48B). - a. Work included. - The contractor shall furnish and place the bituminous macadam road surface shown on the drawings. The surface shall be composed of broken stone and bituminous material applied by the penetration method, with a bituminous seal coat and covering of pea stone. Item 48A includes the road surface to be placed on the new gravel base placed in accordance with the provisions of Paragraph 6-06. Item 48B includes the road surface to be placed on the existing railroad ballast, and includes any grading and rolling of the ballast that may be necessary to prepare the base for the road surface.

b. Materials. - The broken stone for the surface course shall consist of clean crushed rock, thoroughly screened, uniformly graded in size and quality, angular, and free from rounded surfaces; and no flat, elongated or otherwise objectionable stone shall be used. All stone shall meet the following requirements:

No. 1 Stone Square openings	Percent passing
2-1/4"	90 - 100
1-1/4"	0 - 40
3/4"	0 - 5

Pea Stone Square openings	Percent passing
1/2"	90 - 100
1/4"	0 - 20

The bituminous material to be used in this work shall be an approved product for the purpose, either oil asphalt or refined tar, and conforming to all applicable requirements of Federal Specification SS-A-706, "Asphalt; (For use in) Road and Pavement Construction."

c. Placing. (1) Where the road surface is to be placed over existing railroad ballast, the ballast shall be graded and rolled to conform to the sections shown on the drawings. Any ballast that is not suitable, in the opinion of the contracting officer, shall be removed and replaced with new gravel or crushed stone as provided in Paragraph 6-06.

(2) Shoulders shall be relined and graded before the

surface course is spread, in order to hold the broken stone in place and to permit the roller to lap at least one-half the width of the rear wheel when rolling the edge of the top course. A course of No. 1 stone shall then be spread upon the gravel base course to the depth shown on the drawings and dry rolled. The rolling shall be done by a self-propelled three-wheeled roller weighing not less than 10 tons. Before the No. 1 stone is spread, the pea stone shall be deposited alongside the road in convenient piles from which it shall be spread on the surface course as directed. No hauling will be permitted over the No. 1 stone after it has been spread.

(3) The No. 1 stone shall be spread from approved self-spreading vehicles. The course shall be spread and shaped to a true section of such depth that when the surface is finished, the depth shall be as shown on the drawings and the top shall be at the required grade. Rolling shall continue until the course has been satisfactorily compacted to a uniform surface. Any depressions or irregularities which may occur shall be filled with broken stone as directed, and again rolled until the surface is true and unyielding. Precautions shall be taken to prevent the depositing of dirt or other materials in the voids of the broken stone.

(4) No bituminous material shall be applied on stone which has become coated or mixed with dirt or foreign substances. No bituminous material shall be applied unless the entire depth of No. 1 stone is thoroughly dry and the air temperature is at or above 50 degrees F. After the No. 1 stone has been prepared as above, the penetration coat of bituminous material shall be applied at the rate of 2 gallons per square yard by an approved pressure distributor, at approved temperatures appropriate for the grade of bituminous material used, and distributed under approved pressures of from 40 to 60 pounds per square inch.

(5) Immediately after the penetration coat of bituminous material has been applied, a thin layer of clean, dry pea stone shall be broadcast over the treated surface in such quantity as to fill all the surface voids and just cover the treatment uniformly. The surface shall then be brooned to break up all clumps and produce a uniform covering, after which the pavement shall be rolled, in the same manner as specified for the rolling of No. 1 stone, until thoroughly compacted and bonded. Additional pea stone shall be applied as required and directed. Upon completion of the rolling the pavement shall have a smooth, even surface, free from ruts, depressions, or other irregularities.

(6) As soon as practicable after the pea stone has been rolled, the pavement shall be swept clean of any loose material and shall be treated with a seal coat of bituminous material under the same conditions and in the same manner as specified for the penetration coat; except, that the rate of application shall be as directed by the

contracting officer but shall not exceed 3/4 gallon per square yard. Immediately after the seal coat has been applied, a thin layer of clean, dry pea stone shall be broadcast over the surface in such quantity as to uniformly cover the surface with all the stone that can be made to adhere to the bituminous material; care being taken to avoid an excess. This stone shall be broomed and rolled in the manner specified above, until an unyielding, uniform, and well-bonded surface is produced. Any damage to the finished surface caused by the contractor's equipment, shall be satisfactorily repaired at no expense to the Government.

d. Measurement and payment. - The quantities to be paid for at the contract unit prices for Items 48A and 48B, respectively, will be the number of square yards of bituminous macadam road surface of the required quality satisfactorily placed in the work, measured after placing. The contract unit prices shall include all cost of furnishing materials, equipment, tools, labor, and work incidental to satisfactory construction.

18-04. Tile gage. - (Item 49). - a. Work included. - The contractor shall furnish and install the tile gage at the location shown on the drawings, and in accordance with the design and dimensions shown on the drawings.

b. Specifications. - The tile gage shall be furnished and erected in sections as shown on the drawings, and shall be constructed of ceramic mosaic tile of a quality approved by the contracting officer. The tile shall be assembled by pasting on sheets of paper in panels of 1-foot lengths; a sample shall be furnished to the contracting officer for approval before erection. Figure sheets as received from the manufacturer shall be placed in an accurate mold on a glass plate and backed with cement mortar about 1-1/2 inches thick; the mortar shall be a 1 to 1 mixture of cement and sand of suitable consistency when combined with water, and shall be reinforced with expanded metal or wire fabric. Reinforcing shall extend beyond both edges of the mortar to form anchorages as shown on the drawings. After final set, molds shall be removed and the panels shall be cured immersed in water for a period of 10 days. The tile panels may be prepared in convenient lengths of even feet.

c. Payment. - Payment will be made at the contract price for Item 49, "Tile Gage", and shall include all costs of furnishing materials, equipment, tools, labor and work incidental to satisfactory construction.

18-05. Flag pole (Item 50). - a. Work included. - The contractor shall furnish and erect the flag pole with accessories as shown on the drawings or ordered.

b. Materials. - The base shall be constructed of reinforced Class "A" concrete conforming to the requirements of Section IX. The flag pole shall be of heavy pattern, swaged, sectional, copper

bearing tubular steel. Accessories to be furnished by the contractor include a gold leafed copper ball, ball bearing revolving truck, two sets of 3/8-inch manila bolt rope halyard, two 9-inch galvanized cast-iron cleats and an ornamental cast-iron base. The flag pole and accessories shall be similar and equal to the articles manufactured by John E. Lingo & Son, Inc., 28th Street and Buren Avenue, Camden, N. J.

c. Construction methods. - The flag pole shall be ground set in the concrete foundation as indicated on the drawings. The erection of the flag pole shall be in strict accordance with the manufacturer's specifications. After erection, two finish coats of white paint approved by the contracting officer and conforming to Federal Specification of Group "TT" shall be applied to the flag pole and ornamental base over a shop coat of red metal primer.

d. Measurement and payment. - Payment for furnishing and erecting the articles specified above will be the contract price for Item 50, "Flag Pole". The contract price shall include all costs of furnishing, assembling, erecting, cleaning and painting the flag pole complete in all respects, including payment for all materials and labor for the construction of the concrete base.

18-06. Cleaning up. - a. Work included. - The contractor shall remove all construction equipment and all temporary structures built or used by him, shall remove rubbish of all kinds from the site of the work and the contract structures, and from any grounds which he shall have occupied within the limits of the work, and shall leave the site of the work in a satisfactorily clean condition. All materials salvaged shall be the property of the contractor.

b. Payment. - No separate payment will be made for this work but the cost thereof shall be included in the contract prices for Items 1 to 50, inclusive.

U. S. ENGINEER OFFICE
PROVIDENCE, R. I.
MARCH 4, 1940.

Invitation No. 699-40-271

STANDARD GOVERNMENT FORM OF BID
(Construction Contract)

(Place) _____

(Date) _____

To the District Engineer,
U. S. Engineer Office,
819 Industrial Trust Bldg.,
Providence, R. I.

In compliance with your invitation for bids dated March 4, 1940, and subject to all the conditions thereof, the undersigned

_____

a corporation organized and existing under the laws of the State of

_____

a partnership consisting of _____

_____

_____

_____

or an individual trading as _____

_____

_____

of the City of _____

hereby proposes to furnish all plant, labor, and materials and perform all work required for the construction of Birch Hill Dam located on the Millers River, Massachusetts, including all work indicated on the drawings, or required by the specifications, and such incidental work as needed or ordered in writing by the contracting officer, in strict accordance with the specifications, schedules, and drawings, for the consideration of the following prices:

Item No.	Designation	Unit	Quantity	Unit price	Amount
1	Diversion and Care of River	Job	-		
2	Clearing and Grubbing	"	-		
3	Common Stripping	cu.yds.	37,700		
4	Common Excavation - General	" "	162,000		
5A	Common Excavation - Access Road	" "	2,500		
5B	Common Excavation - Access Road Structures	" "	400		
6	Common Excavation - Cut-Off Trench	" "	6,500		
7	Common Excavation - Borrow Area A	" "	140,000		
8	Common Excavation - Borrow Area for Access Road	" "	13,000		
9	Common Excavation - From Stockpiles	" "	55,000		
10	Rock Excavation	" "	58,000		
11	Line Drilling and Presching	sq.ft.	18,000		
12	Selected Impervious Fill	cu.yds.	65,000		
13	Impervious Blanket Fill	" "	88,000		
14A	Random Fill	" "	73,600		
14B	Pervious Fill	" "	78,400		
15	Gravel Bedding	" "	3,000		
16	Fill (Unclassified) - Access Road	" "	14,500		
17	Compacted Backfill	" "	1,000		
18	Semi-Compacted Backfill	" "	5,600		
19	Gravel for Roads	" "	2,000		
20	Dumped Rock Fill	" "	38,000		
21	Hand-Placed Riprap	" "	3,000		
22	Grouted Stone Gutters	sq.yds.	350		

Item No.	Designation	Unit	Quantity	Unit Price	Amount
23	Gravel Filled Drains	lin.ft.	1,000		
24	12-Inch Corrugated Metal Pipe	" "	54		
25	Core or Rotary Drilling in Rock or Concrete	" "	1,300		
26	Ordinary Drilling	" "	850		
27	Pressure Grouting	cu.ft.	1,300		
28	Portland Cement	bbl.	17,600		
29	Class "A" Concrete - Channel Lining and Gate Structure	cu.yds.	2,040		
30	Class "B" Concrete - Outlet Works Retaining Walls	" "	390		
31	Class "A" Concrete - Road and Bridge Structures	" "	170		
32	Class "B" Concrete - Spillway Weir	" "	12,200		
33	Steel Reinforcement	lbs.	164,000		
34	Operating House Superstructure	job	-		
35	Miscellaneous Structural Steel	lbs.	9,000		
36	Miscellaneous Iron and Steel	"	6,700		
37	Miscellaneous Wrought Iron Pipe	"	5,800		
38	Miscellaneous Black Steel Pipe	"	3,800		
39	Miscellaneous Brass and Bronze	"	50		
40	Copper Water Stops	"	160		
41	Lighting and Power	job	-		
42	Installing Gates and Accessories	lb.	200,000		
43	Installing Conduit Linings	"	126,000		
44	Furnishing and Installing Crane	job	-		
45	Furnishing and Installing Gasoline-Electric Standby Unit	"	-		

Item No.	Designation	Unit	Quantity	Unit Price	Amount
46	Highway Cable Fencing	lin.ft.	2,440		
47	Highway Chain Link Fencing	" "	2,620		
48A	Bituminous Macadam Road Surface on New Gravel Base	sq.yd.	7,700		
48B	Bituminous Macadam Road Surface on Existing Railroad Ballast	" "	6,000		
49	Tile Gage	job	1		
50	Flag Pole	"	1		
	TOTAL				

Notes: (1) All amounts and totals given above will be subject to verification by the Government. In case of variation between unit bid price and totals shown by bidder, the unit price will be considered to be his bid.

(2) All bids must be for the entire work and must have each blank space filled.

(3) The quantities of each item of the bid as finally ascertained at the close of the contract, and the unit prices of the various items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect costs connected with it.

PLANT TO BE USED ON THE WORK

(See Invitation for Bids and Paragraph 1-09 of the specifications)

Note:- Use separate line for each major item.

No.	Name	Kind	Capacity	Age and Condition

Excavation Equipment

Material Handling Equipment

Pumping Equipment

Earth Embankment Equipment - Rolled Fill

(Spreading and Rolling)

Rock Fill and Riprap Equipment

Concreting Equipment

Drilling Equipment

Machinery

(The bidder shall submit catalogues and information showing all details of permanent equipment he proposes to install in the operating house.)

Miscellaneous Equipment

EXPERIENCE. - (See Invitation for Bids)

DATA SHEETS

The bidder shall submit with his proposal the following information regarding the equipment he proposes to furnish. Statements so made by the bidder are intended to be, and are, express warranties.

DATA SHEET

25 KW GASOLINE-ELECTRIC GENERATOR UNIT

1. Engine: (Manufacturer) _____

   Number Cylinders _____

   Bore and Stroke _____

   Piston Speed at Rated Output _____

   Lbs. Fuel per kw-hr. at 100% Rated Output of Generator _____

   Lbs. Fuel per kw-hr. at 75% Rated Output of Generator _____

   Battery (Make and Capacity) _____

   Governor (Make and Type) _____

   Net Weights: Engine _____ Pounds

   Generator and Exciter _____ Pounds

   Complete, Unit, including Common Base _____ Pounds

2. Electric Generator: (Manufacturer) _____

   Rating:

   Efficiency, at 80% lagging power factor, as determined in accordance with American Institute of Electrical Engineers standardization rules, will not be less than the following:

   Full Load _____%; 3/4 Load _____%; 1/2 Load _____%.

DATA SHEET

ELECTRIC SWITCHBOARD

Manufacturer _____

Overall Dimensions (Approx.) _____

DATA SHEET

TRAVELING CRANE

1. Manufacturer's Name _____

2. Type or Model _____

3. Capacity _____

4. Lifting Speed _____

5. Hoist Drum Diameter _____

6. Diameter of Sheaves _____

7. Number of Ropes _____

8. Rope Diameter _____

9. Motor:

   a. Manufacturer's Name _____

   b. Type and Model No. _____

   c. Rated Horsepower _____

It is hereby warranted that in the event award is made to the undersigned there will be used in the performance of the work covered by the contract only such unmanufactured articles, materials and supplies as have been mined or produced in the United States and only such manufactured articles, materials, and supplies as have been manufactured in the United States all from articles, materials, or supplies, mined, produced or manufactured, as the case may be, in the United States, except as noted below or otherwise indicated in this bid or authorized in the specifications.

The undersigned agrees, upon receipt of written notice of the acceptance of this bid within 60 days after the date of opening of the bids, to execute the standard forms of Government contract, in accordance with the bid as accepted, and to give the required performance and payment bonds, with good and sufficient surety or sureties, for the faithful performance of the contract, and for the protection of all persons supplying labor and materials in the prosecution of the work, within 10 days after the prescribed forms are presented for signature.

Performance will begin within 10 calendar days after the date of receipt of notice to proceed and will be completed within 550 calendar days after date of receipt of said notice to proceed.

_____
(Bidder)

_____
(Address)

By _____
(Name) (Title)

NOTE:- Read Standard Government Instructions to Bidders before preparing this bid.